The World of SATELLITE TV

AUSTRALIA/NEW ZEALAND EDITION

BY MARK LONG

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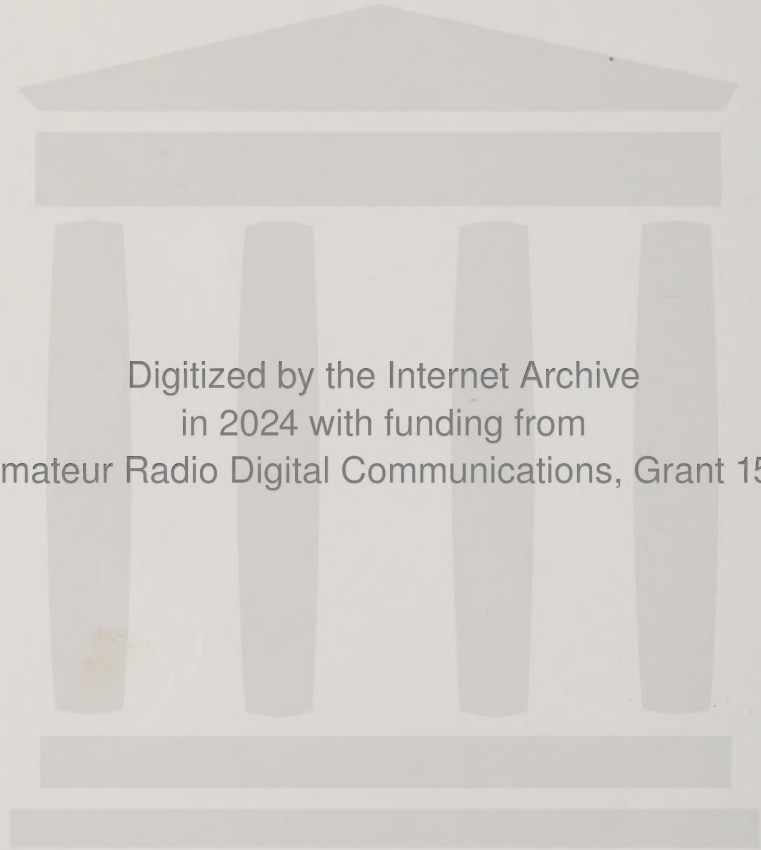

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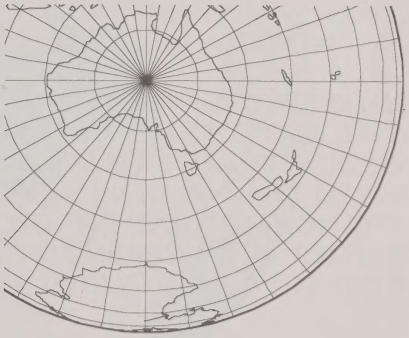
AUSTRALIAN EDITION



INCLUDING NEW ZEALAND
& THE SOUTH PACIFIC

THIS NEW EDITION OF *THE WORLD OF SATELLITE TV* FOR AUSTRALIA AND NEW ZEALAND IS DEDICATED TO ARTHUR C. CLARKE IN HONOR OF THE 50TH ANNIVERSARY OF HIS PUBLICATION OF A VISIONARY ARTICLE ENTITLED "EXTRATERRESTRIAL RELAYS" WHICH APPEARED IN THE OCTOBER, 1945 ISSUE OF *WIRELESS WORLD MAGAZINE*.

HIS "MODEST" PROPOSAL GOVERNING THE USE OF A UNIQUE ORBITAL ARC ABOVE THE EARTH'S EQUATOR FOR THE WORLD-WIDE BROADCASTING OF TELEVISION AND RADIO PROGRAMMING HAS LED TO UNFORESEEN TECHNICAL, SOCIAL AND POLITICAL CHANGES AROUND THE GLOBE. WHAT'S MORE, IT MAY TAKE ANOTHER FIFTY YEARS BEFORE WE CAN TRULY ASSESS THE FULL IMPACT OF THIS REVOLUTIONARY PROPOSAL.

THE WORLD OF SATELLITE TV

AUSTRALIAN EDITION

BY MARK LONG

INCLUDING NEW ZEALAND & THE SOUTH PACIFIC

MARK LONG ENTERPRISES, INC.
WINTER BEACH FLORIDA U.S.A.
CHIANG MAI THAILAND

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FOREWORD

When the history books are written for the 20th century, it is my opinion that the subject so well covered in this book, direct home reception of satellite television, will emerge as having had an effect equal to that of the automobile. It was a total surprise—even to those of us who have been involved from the beginning in the engineering and planning of space technology—that widespread use of private receiving terminals would occur so early in the 1980s. The result has been dramatic both in technical advances and price decline.

The invention of the transistor, like all non-linear advances, was simply not foreseeable. Nor was this present satellite TV revolution. Even after the invention of the transistor, none of us could imagine the marriage of materials, science, physics, the computer, and industrial technology which would give us the ability to build devices with such short paths and so few electrons that the amount of noise contributed by the transistor would be miniscule. Translated into consumer terms, yesterday's high-priced low noise amplifier is now an inexpensive unit with performance beyond even the wildest dreams of a few years past.

Through such developments in solid state physics coupled with similar advances in the complexity and reliability of the satellites, it is now technically and economically possible to make wide-band information available in the form of television, audio, and digital data to every human being on Earth.

Technology generally advances not because of planning, but because like the mountain, "it's there". Our microwave technology is now so well developed that it is no longer necessary to treat it as magic—we can ignore it in the same way that we ignore gravity. However, it cannot be ignored by our social and political planners any more than they can ignore the fact that they sit down in chairs rather than drift about the room. It is important that everyone have some understanding of at least the technical possibilities and the social implications so that we can make effective use of the technology.

Readers of this book will come to realize that they are looking at a system which has reached technical maturity and already has made a major impact on humanity. The unification of Germany and the fall of the "Iron Curtain" were due in large measure to the power of satellite technology.

With this book you have bought a ticket for a launch into the future—a rocket to much personal enjoyment—but also to a place from which you may be able to contribute to both the technology and its beneficial effects. Only those who read and then advance to having their own satellite TV system will be able to make an intelligent assessment of what this truly marvelous technology can mean to mankind.

H. Taylor Howard,
Professor Emeritus, Stanford University
& Chief Technical Officer
Chaparral Communications

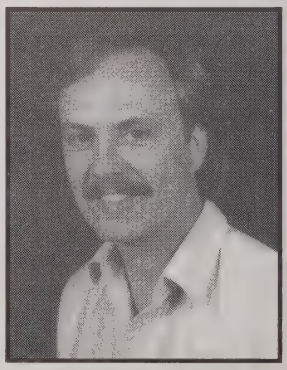
ABOUT THE AUTHOR

For the past decade, Mark Long has been the world's leading journalist in the field of satellite communications. He has written more than 300 articles for magazines such as *Satellite Orbit, Satellite Direct, Orbit Video, TVRO Dealer, Satellite Retailer, Satellite TV Week, Cable and Satellite Europe, Popular Communications, and Tele-satellit.* Dozens of his articles also have appeared in the newspapers of the Los Angeles Times Syndicate.

Mr. Long also is the author of several books on satellite communications, including the best-selling **World of Satellite TV, The Down To Earth Guide to Satellite TV,** and **The Ku-band Satellite Handbook**. He is the founding publisher of **The World Satellite Almanac**, a standard reference book for the commercial satellite communications industry. More than 400,000 copies of his satellite-related books have been printed.

A long-time radio amateur radio operator (WA4LXC), Mark Long also is a member of the American Institute of Aeronautics and Astronautics and the International Society of Satellite Professionals. The author currently resides in Bangkok, Thailand.

ABOUT THE EDITOR



Jeffrey Keating is the co-author of the million-selling **Big Dummy's Guide to CB Radio, The Inclined Orbit Satellite Tracking Guidebook** and the U.S. edition of **The World of Satellite TV**. A consultant in the field of international satellite communications, Mr. Keating has provided numerous companies with advice on the transmission and reception of video, voice, and data via satellite. Over the years, Jeffrey Keating has been an FM broadcast station manager, an amateur radio (WB4KDH) net control operator for major relief efforts in Central America, and a pioneer member of the U.S. satellite TV industry.

INTRODUCTION

Over fifty years ago, the advent of the "little screen" radically transformed the world's entertainment landscape. The changes wrought by the introduction of broadcast television were staggering, forever changing how we see both ourselves and the world in which we live. Well, hold on to your hats, because here we go again! Standing traditional broadcast TV on its head, the present-day satellite TV revolution is delivering crystal-clear pictures and high quality sound into millions of living rooms around the globe.

Satellites have become the superhighways of the Information Age. The changes they have brought to our lives are as dramatic as those from any other technological development in this century. Boundaries of money, nation, time, and space are dissolving in the cooperative linkage of the entire world which is sharing the resources and technology of space.

At this very moment, distant communications satellites are beaming a continual stream of news and entertainment into our homes and businesses. To tune in, all you need is a bowl-shaped antenna called a dish and an electronics package that converts futuristic satellite transmissions into signals that can be displayed by your regular TV set.

Sounds like a dream? It isn't. More than twenty-five million households worldwide already own satellite dishes. Not all of these satellite dish owners live in rural areas, either. Many urban and suburban households that could access local cable TV systems are tuning in to satellite TV instead. The reason? Satellite TV can give you interference-free, studio-quality reception, which is worlds above what most of us can pick up from our local broadcast and cable TV affiliates. Complete freedom of choice is another important area where satellite TV wins hands down. You get to choose the services and special events that *you* want to watch, instead of opting to let your local cable company make these choices for you.

When you own a satellite dish, literally dozens of TV and radio channels are just the push of a button away. As you tune through the available satellite channels, you will encounter one box office extravaganza after another. Recently-released smash-hit movies that are uncut and uninterrupted flash onto the screen, along with critically acclaimed films and movie classics. There are dozens of major sports events in virtually every field to choose from, including live professional and collegiate competitions, the Olympics, World Cup Soccer, and the Asian Games. What's more, you can access coverage of your favorite sports teams—even if the events are blacked out in your local area.

You also will be dazzled by a flurry of up-to-the-minute news and weather reports, children's programming, and music videos. Major TV stations from within the region also can be received via satellite so that you can stay current with the very latest local developments.

The larger home satellite dishes can even put you in the studio control room, where you can choose from a variety of live, unedited news feeds that originate right from the scene of the action. It is a common occurrence to see news reporters rehearsing their lines or getting their

makeup touched up as they wait to deliver their stories, or to overhear fascinating comments that weren't intended for reception by the general public.

This book is not only a guide to the exciting new TV services coming your way via satellite, but also a detailed manual for the selection and operation of your own personal system. A home satellite dish not only will serve to entertain you and your family, but also will offer you immediate access to information from around the world. This book will show you how the satellite network functions and explain in simple terms the esoteric electronics, so that you can get a basic understanding of how it all works. We also review the latest generation of satellite television technology, direct broadcast satellites (DBS), which already has become a major force in TV broadcasting in many parts of the world.

Satellite technology is showing us that we are no longer a planet of isolated peoples and cultures: we now live in a real global village. This special edition of *The World of Satellite TV* for Australia and the South Pacific explains how to receive a wide spectrum of international programming both at home and at other locations within the region.

You don't have to be an expert to get involved in satellite TV; it can be as simple as calling your local satellite retailer for a turnkey installation. But even then, a good understanding of the technology allows you to make an informed choice, and to get more out of your home system. This manual will help you get started, and will serve as a handy reference guide to the exciting new world of satellite TV.

EXPLORING THE SATELLITE GALAXY

In October of 1945, a gifted science and science fiction writer proposed the extraordinary idea of using stationary satellites to beam television and other communications signals halfway around the world. Arthur C. Clarke (*2001: A Space Odyssey, Rendezvous With Rama,* etc.) reasoned that if a satellite were positioned high enough above the equator, its orbit could be matched to the rotation of the Earth. The satellite would then appear to remain fixed in one particular spot in the sky. Because a satellite's orbital speed varies with its distance from Earth, a "geostationary" orbit is only possible directly above the equator, in a narrow belt about 22,300 miles out. Although it took the technology a while to catch up with Mr. Clarke's concept, today there are a number of satellites taking advantage of his original thinking. In recognition of his pioneering vision of satellite telecommunications, this band of outer space "real estate" is called the *Clarke Orbit.*

Mr. Clarke also reasoned that a single satellite located above the Earth could effectively replace thousands of local transmitting facilities at a mere fraction of their cost. He first raised the possibility of direct-to-home (DTH) satellite reception as the most efficient means of supplying television and radio programming. At first this idea was not taken very seriously in the scientific community, probably because it had been expressed by a writer who dabbled in the art of science fiction. But science fiction is often a springboard for new ideas and theories, some of which turn into science fact.

In 1957, the Soviet Union launched Sputnik, the world's first artificial satellite. Although it only transmitted a simple beacon that could be tracked as the satellite orbited the Earth, its successful flight had implications that challenged the rest of the world to develop the advanced technology necessary for the exploration of space.

Several additional technological developments were necessary in order to make satellite communications possible. Solar panels composed of thousands of tiny photovoltaic cells enabled these remote relay stations to generate their own electricity from the Sun, providing the satellites with reliable operating power. The invention of first the transistor and then the integrated circuit allowed technicians to miniaturize all of the components so that a relatively small and lightweight package could be launched into high orbit.

In 1962, the United States launched Telstar, the world's first satellite used for television programming. Because satellite launching techniques were still in their infancy, Telstar was not put into geostationary orbit. Its elliptical orbit had to be tracked by ground stations, and it was only overhead at any given

location during a portion of each day. In 1965, the Early Bird satellite became operational as the world's first commercial geostationary satellite; it relayed telephone calls, telex, news and other television programming from one side of the Atlantic to the other. It also could carry 240 telephone communications, or one television channel, at a time. Early Bird was the forerunner of a new series of satellites operated by the International Telecommunications Satellite Organization (INTELSAT).

First Canada, then the United States, and subsequently other countries constructed their own domestic geostationary satellite systems. Each new satellite had greater capabilities, expanding our ideas of the technologically possible. As of early 1995, there were more than 120 domestic and international telecommunication satellites in geostationary orbit over the Earth's equator.

UPLINKS & DOWNLINKS

Each satellite is both a receiver and a transmitter. First, a ground station, also called the *uplink*, sends a signal to the satellite. The satellite automatically changes the signal's frequency and retransmits it back to stations on the ground. This second signal path is called the *downlink*. A satellite is much like a broadcasting tower 22,300 miles high, an automatic relay station that can transmit into a coverage area as large as 42 percent of the Earth's surface.

Each satellite has a number of redundant modules which are spares that can be switched into operation in the event of any malfunction of the primary parts. A satellite costs US$ 120 million or more for the spacecraft and launching rocket—too expensive a project to allow parts failure to disrupt the services. There aren't any repairmen who can make a

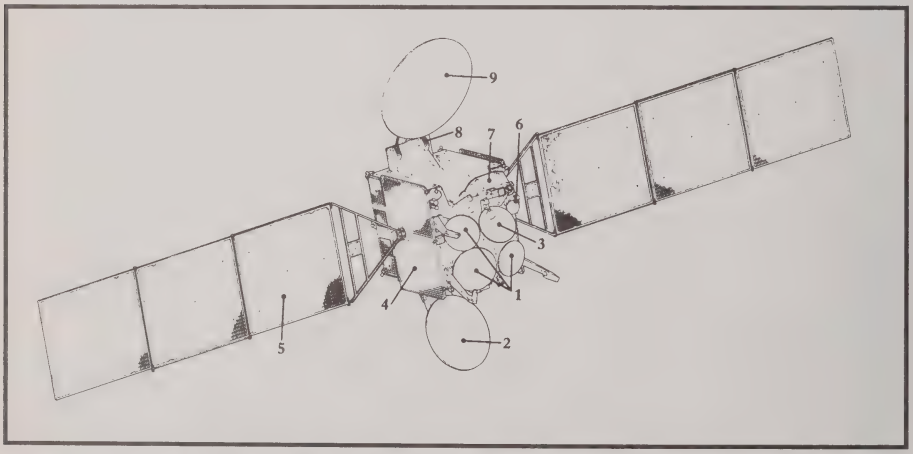


FIG. 1-1. INSIDE VIEW OF THE INTELSAT VII COMMUNICATIONS SATELLITE. (1) STEERABLE KU-BAND SPOT BEAM ANTENNAS; (2) C-BAND RECEIVE HEMI/ZONE ANTENNA; (3) C-BAND STEERABLE SPOT BEAM ANTENNA; (4) THERMAL RADIATOR; (5) SOLAR ARRAY; (6) C-BAND GLOBAL COVERAGE HORNS; (7) C-BAND TRANSMIT HEMI/ZONE ANTENNA FEED ARRAY; (8) HINGES; (9) C-BAND TRANSMIT HEMI/ZONE ANTENNA. (COURTESY INTELSAT.)

service call to the Clarke Orbit. But ground control stations can remotely switch in backup facilities in case of failure.

SATELLITE TRANSPONDERS

Every satellite serving the Asia/Pacific region has several channels, called *transponders*, that process communications traffic. Most of the available satellites have ten or more transponders in operation, each capable of transmitting one or more TV signals or thousands of simultaneous telephone conversations. Radio networks are also present on many transponders, as well as teletext news, computer information services, and other data transmissions.

Every transponder's signal is also polarized. Signals of opposite polarization are received separately at the receiving station. Polarization allows more channels to fit into the limited range of frequencies allocated for the satellites. Satellites such as Asiasat 1 carry twelve horizontal and twelve vertical transponders using frequencies which overlap each other without causing interference.

Satellite transponders operate on frequencies high above those used by the regular TV channels. Since these superhigh frequencies are not affected by ad-

HERTZ (HZ) REFERS TO THE NUMBER OF CYCLES OR WAVES PER SECOND OF A GIVEN SIGNAL. 1 MEGAHERTZ (MHZ) = 1,000,000 CYCLES PER SECOND (CPS); 1 GIGAHERTZ (GHZ) = 1,000,000,000 CPS.

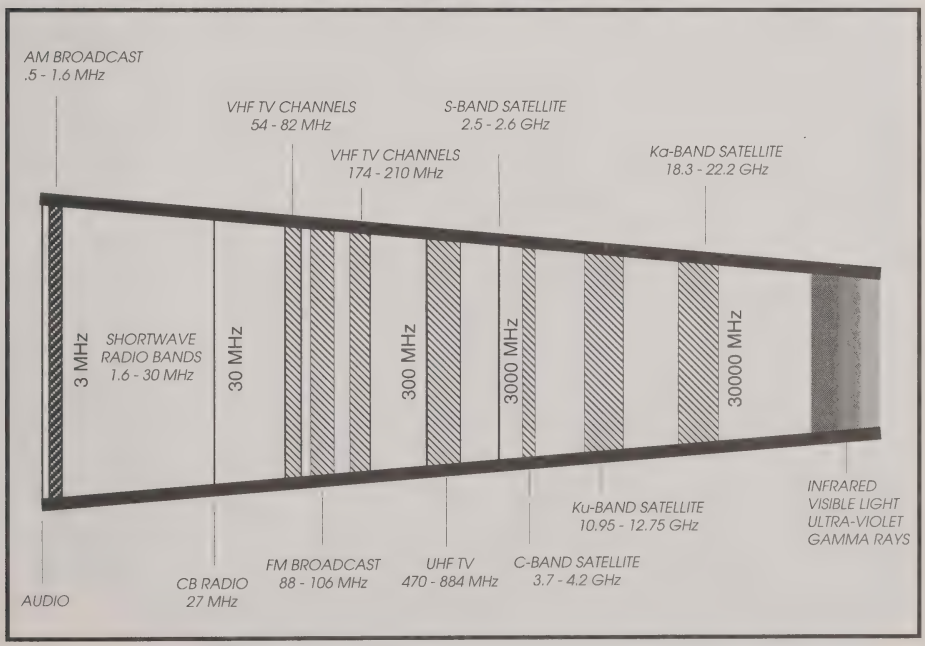


FIG.1-2. THE ELECTROMAGNETIC SPECTRUM.

verse weather conditions or sunspot activity, satellites offer extremely reliable communications coverage 24 hours a day. Operating at frequencies of several billion cycles per second, or Gigahertz (GHz), satellite transponders relay their microwave signals via two distinct communication bands. The majority of Asia's home satellite TV services are using the range of frequencies from 3.7 to 4.2 GHz, often referred to as the "C" band. In Australia, Thailand, and Japan, however, satellites operating within higher frequency spectrums ranging from 11.9 to 12.75 GHz are broadcasting satellite TV programs directly to homes within their respective countries. Future satellites planned for launch by Malaysia and South Korea in the mid-1990s also will use these higher frequencies to transmit TV programs directly to home satellite TV receiving systems. The entire spectrum of frequencies ranging from 10.95 to 12.75 GHz is referred to as the "Ku" (pronounced "Kay-You") band.

FOOTPRINTS

The satellite's antenna transmits the television signal in a particular shape, called a *footprint*, pointed at its coverage area. Each satellite generates one or more characteristic footprints, with the signal strongest at the center of each footprint's coverage area and diminishing outward from there. Those who live at locations toward the center of any footprint can receive the signals with a smaller dish antenna than those out on the edges. For example, a TV viewer in Sydney, Australia may need an antenna that is 1.8 meters in diameter to receive

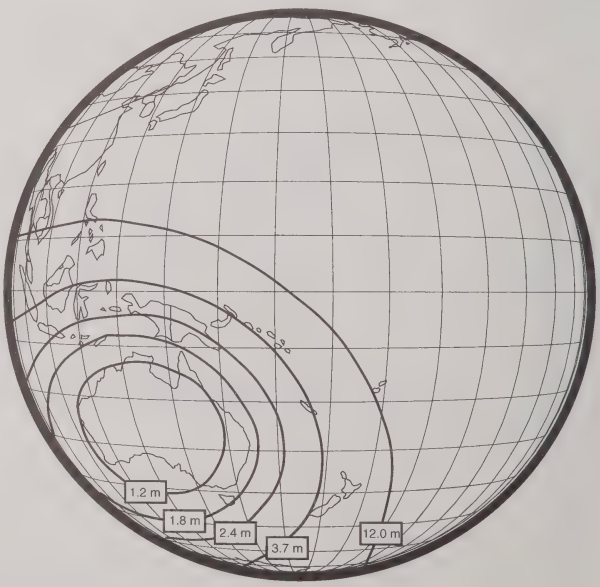


FIG. 1-3. EACH INDIVIDUAL SATELLITE PRODUCES ITS OWN UNIQUE COVERAGE BEAM OR BEAMS, CALLED "FOOTPRINTS." THOSE WHO LIVE AT LOCATIONS TOWARD THE CENTER OF ANY FOOTPRINT CAN RECEIVE THE SIGNALS WITH A SMALLER DISH THAN THOSE OUT TOWARD THE EDGE OF THE COVERAGE BEAM.

the same quality picture from a particular Ku-band satellite as an individual in Auckland, New Zealand using an antenna which is 3.7 meters in diameter.

C-band satellites such as Asiasat 1 transmit low power signals, usually in the neighborhood of eight to sixteen watts—only about as much as a car taillight bulb uses. By the time the satellite signal reaches the ground, it is very weak indeed. That is why large aperture antennas (commonly 2 to 4 meters in diameter) must be used to pull the signal out of the background noise.

Today's Ku-band satellites transmit medium-powered signals, usually in the neighborhood of twenty to fifty watts. In Australia, the medium-powered Optus B satellites transmit using fifty watts of power per Ku-band transponder, while high-powered DBS satellites such as the BS-3 spacecraft (Japan), Asiasat 2, and Apstar 2R have been designed to transmit using 100 watts or more of power per Ku-band transponder. Higher power from the satellite directly translates into smaller dishes down on the ground—as small as 45cm in diameter.

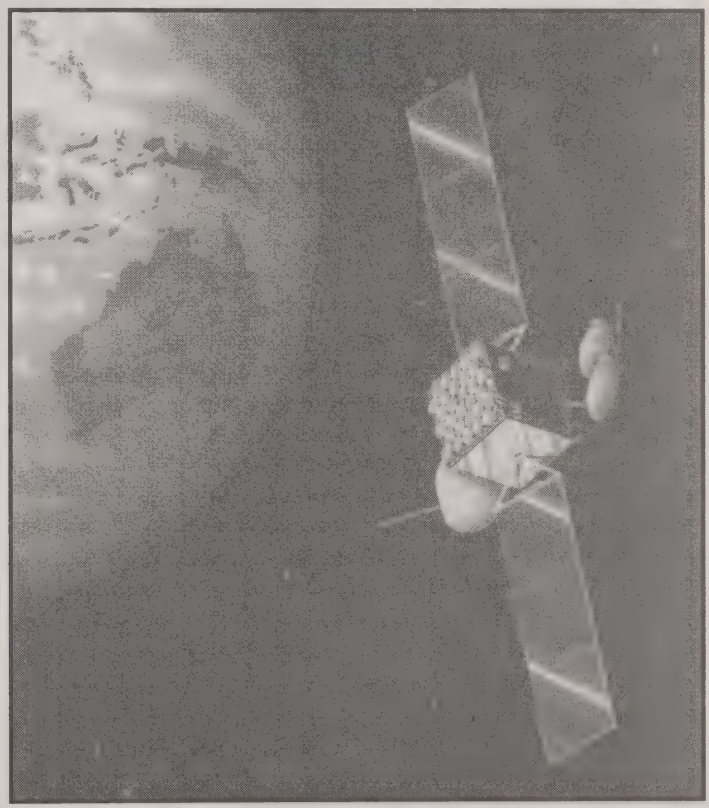


FIG. 1-4. AN ARTIST'S RENDITION OF AN OPTUS B SATELLITE. (COURTESY HUGHES AIRCRAFT.)

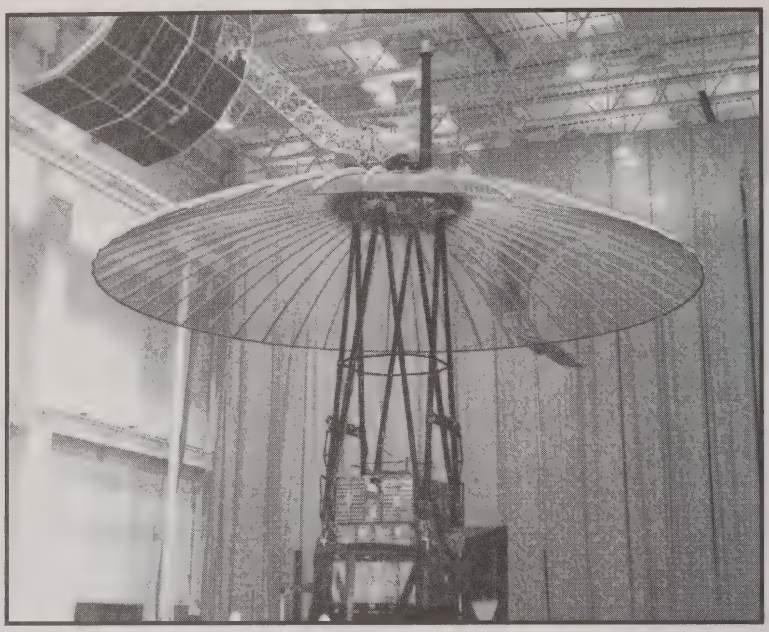


FIG. 1-5. THE ATS-6 SATELLITE UNDERGOING TESTS PRIOR TO LAUNCH. (COURTESY NASA.)

THE ROAD TO HOME SATELLITE TV

In the 1960s and early 1970s, satellites were the exclusive domain of various government-owned telecommunications authorities which had the wherewithal to transmit TV programming via satellite. Reception of these early transmissions required extremely large parabolic dishes and expensive electronic components, which only the national PTTs could afford. It wasn't until 1975 that private individuals attempted to directly receive satellite TV signals via a home "earth station".

At that time, an American satellite (ATS-6) was leased to India for an experimental project that transmitted television programming to satellite earth stations located in remote villages across the subcontinent. In the Summer of 1975, Arthur C. Clarke became the first private individual in the world to receive satellite TV broadcasts via a satellite TV receiving station installed at his home in Colombo, Sri Lanka.

Shortly thereafter, English amateur radio enthusiast and BBC technician Stephen J. Birkill learned of the Indian SITE project and set out to build his own receiver and antenna for these transmissions. His initial reception of the SITE broadcasts took place in December of 1975. From well outside the satellite's footprint, with a five-foot antenna made from screen, he proved that private individuals with limited resources could still bring satellite television into their own homes.

Back in the United States, Home Box Office and Ted Turner's WTBS began transmitting their respective programming services via satellite to American

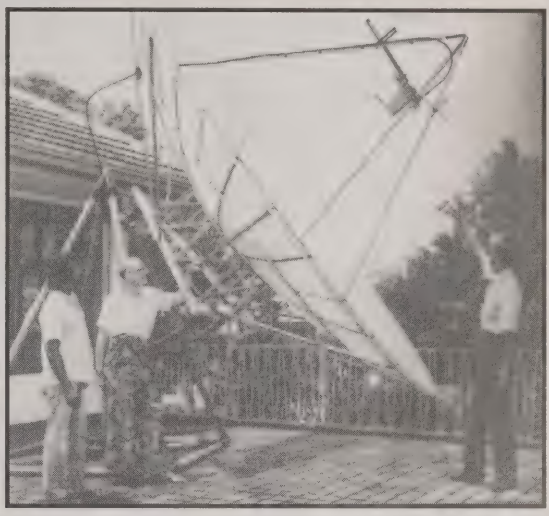


FIG. 1-6. THE WORLD'S FIRST HOME SATELLITE RECEIVING SYSTEM WAS INSTALLED FOR ARTHUR C. CLARKE IN THE SUMMER OF 1975. (COURTESY A. C. CLARKE.)

cable TV systems. Other American program services soon joined HBO and WTBS on Satcom 1—America's first cable TV satellite.

Several people within the American cable and electronics industry began to think about the possibilities of direct home reception. Robert Cooper, then editor of the U.S. cable TV industry's *CATJ* magazine, obtained an experimental license from the FCC that authorized the installation of a satellite receiving system at his home in rural Oklahoma. In an October, 1978 issue of *TV Guide,* he brought the potential of home satellite TV to the attention of millions of Americans.

The explosion in demand for satellite-delivered cable systems caused the electronics industry to increase production,

FIG. 1-7. RECEPTION OF THE EARLY ATS-6 SATELLITE BROADCASTS FROM THE U.K. (COURTESY S.J. BIRKILL.)

which dramatically reduced the cost of some of the more sophisticated items essential for satellite reception. Through increased production, manufacturers also were able to obtain higher performance levels from their products, which made it easier for small dish antennas to provide good results.

In 1986, U.S. programmers such as Home Box Office and CNN began to market their satellite services directly to American home dish owners. Other American programmers soon followed their example, making home satellite TV a hot commodity.

In 1994, American companies DirecTv and USSB inaugurated the first high-powered direct broadcast satellite services for the United States, collectively transmitting more than one hundred and fifty channels of TV programming to American homes equipped with low-cost digital receivers and antennas no more than eighteen inches in diameter. Suddenly home satellite TV was within the reach of millions of American homes which previously had not been served by either cable or the large antenna C-band satellite receiving systems.

THE ADVENT OF HOME SATELLITE TV IN THE ASIA/PACIFIC REGION

On April 7, 1990, Asiasat 1—the first commercial communications satellite designed for Asian countries—was launched into space. The satellite, which generates two regional beams centered over mainland China and Southeast Asia, was designed to transmit as many as 24 satellite TV channels.

On April 19, 1991, Hong Kong's Satellite Television Asian Region (STAR TV) began using Asiasat to transmit a multichannel Asian television service to cable and home satellite TV systems located in Asia, India, and the Middle East. Today, STAR TV transmits news, sports events, music videos, pay TV movies, and other entertainment programs into fifty-four countries in Asia and the Middle East.

In April of 1992, CNN International and ESPN began transmitting Asian versions of their American cable TV services via satellite. Since then, additional satellite TV services—such as Home Box Office, The Discovery Channel (TDC), NBC, Asian Business News (ABN), Turner International, Country Music Television (CMT) and Australia Television International (ATVI)—also have begun to deliver regional services to Asian TV viewers.

Australian domestic satellites have been transmitting national and regional TV programming to remote communities in the Australian Outback since 1986. Because the available programming was limited to what was already being transmitted terrestrially in major urban areas, the popularity of this new technology was severely limited.

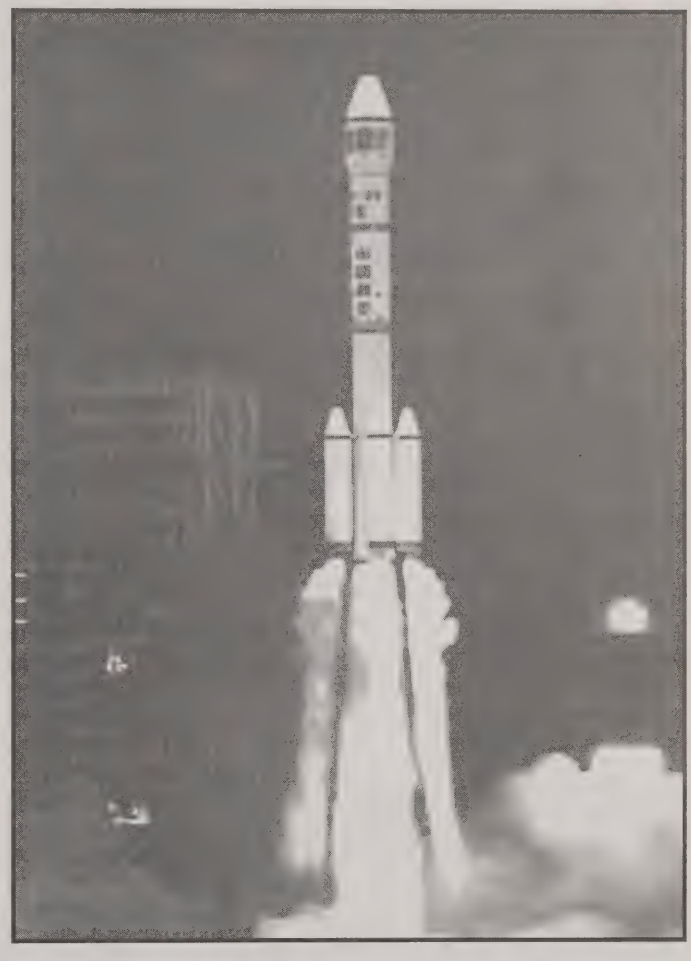
In 1995, however, Australian companies began delivering a range of new pay TV services via the Australian Optus B satellites. Depending on location, these services are either received terrestrially (in major urban areas) or via tiny satellite receiving dishes (in small communities and rural areas).

Now the cost of owning an earth station is lower than ever before, offering new innovative features that allow you to cruise effortlessly from satellite to satellite and from channel to channel, all by wireless remote control. Not limited by the boundaries of space and time, a personal satellite system will serve as your gateway to the "Global Village" and beyond.

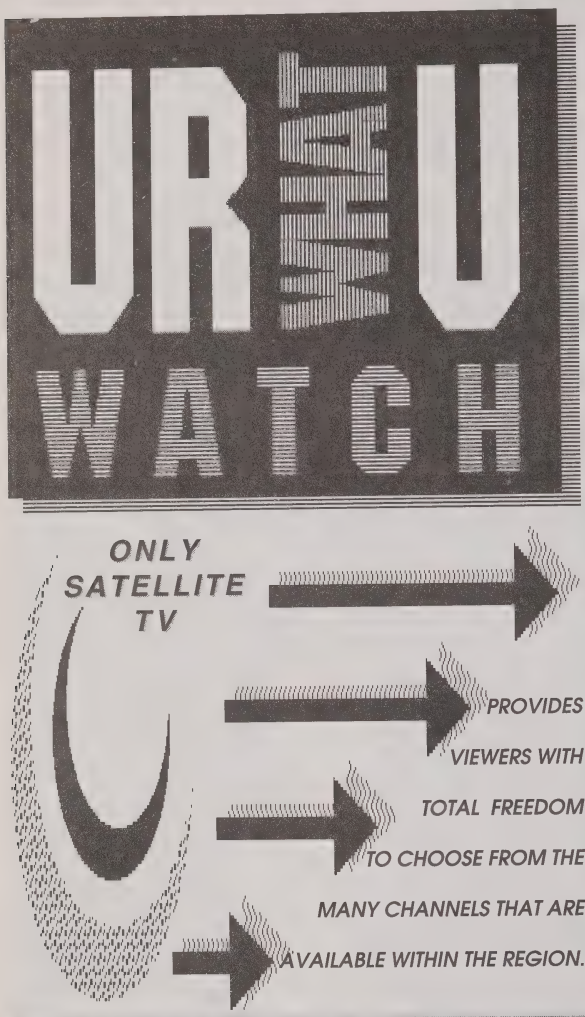
WSTV 2

THE WORLD OF SATELLITE ENTERTAINMENT

Today's communication satellites are owned and operated by large organizations such as INTELSAT, PanAmSat and Rimsat (U.S.A.), Optus (Australia), Asiasat and Apstar (Hong Kong), Satelindo (Indonesia), Shinawatra (Thailand), and the governments of India and the People's Republic of China. These entities assume the initial cost of building, launching, and operating a satellite—over US$120 million in most cases. They are authorized by government-controlled communications agencies to lease and/or sell transponders to smaller companies on a "common carrier" basis, where the satellite com-



2.1. A SATELLITE LAUNCH. (COURTESY CHINA GREAT WALL INDUSTRY CORPORATION.)



THE QUESTION IS: WHO DECIDES WHAT YOU WILL BE WATCHING?

pany is the carrier and the user provides the programming.

SATELLITE TV PROGRAMMING

Private individuals can now use home satellite TV systems to receive a cornucopia of television and radio programming. While many of the available programs are advertiser-supported and are transmitted in the clear, others are encrypted and require the use of a decoder and the payment of a monthly subscription fee for their reception.

Not all countries in the Asia/Pacific region permit private individuals to own and operate satellite TV receiving systems. In Asian countries such as China, Malaysia, and Vietnam, where home satellite TV has been officially banned, tens of thousands of homes already have satellite TV systems and many more are being installed each day. In these countries, the national governments believe that they should decide what their citizens will watch. Satellites, however, do not recognize any political boundaries; the signals can be received throughout each satellite's intended coverage area and it is difficult to prevent anyone from receiving these signals at their homes if they really want to do so. It is not the intention of this book to encourage any reader to violate local laws and it is the responsibility of the reader to seek out the legal status of satellite TV in his or her respective state or municipality. It is the author's belief, however, that each individual should have the right to choose the programming that he or she wishes to watch.

Two types of satellite receiving systems are currently available: those which use a small aperture antenna (usually less than three feet in diameter) and those which use a large aperture antenna (usually eight or more feet in diameter). Low-cost, small-aperture receiving systems are dedicated to receiving domestic TV programs from a single satellite, while the more expensive, large aperture receiving systems can receive regional and international TV programs from multiple satellites. The small aperture receiving systems now available in countries such as Australia and Thailand use high-performance digital receivers to provide the highest possible quality pictures and sound.

Sports. It is now possible to view a dazzling array of athletic competitions from around the world, including live coverage of cricket, football, soccer, basketball, tennis, volleyball, and baseball games. There are literally hundreds of hours of sporting events carried via satellite each week, more than enough for even the most dedicated fan. Owners of large diameter dishes capable of receiving multiple satellites also have access to "wild" sports feeds, transmissions by broadcasters from distant sports arenas back to their respective TV studios.

Since satellites play such a vital role in TV distribution these days, there is a reasonable chance that any major international sports event will be available to large aperture C-band satellite dish owners via one of the international INTELSAT and PanAmsat satellites serving the Pacific Ocean Region. These satellites are used to relay sports events such as the Olympics and the World Cup Soccer Games to an international audience.

Movies. Pay TV movie channels feature many popular and critically-acclaimed films. These channels also offer dramatic performances, mini series, comedy, talk shows, documentaries and other

FIG. 2-2, 2-3, & 2-4. AVAILABLE STAR TV PROGRAMMING ON THE ASIASAT 1 SATELLITE INCLUDE BOTH VIDEO AND AUDIO PROGRAM SERVICES.

entertainment. The various national TV networks available via satellite also offer a selection of movies during the evening hours.

News and Information Channels. Numerous news channels, including CNN International, NBC-Asia (ANBC), Asian Business News (ABN), and BBC World Service Television, are transmitted via satellite on a 24-hours-a-day basis. These channels offer a wide variety of news and informational programs, including live coverage of major international and regional events. The various national broadcast networks using satellites within the region also transmit regular daily news programs.

Some of the more interesting satellite TV news transmissions that are available to large aperture dish owners do not occur on a scheduled basis. Unedited and unexpurgated, these raw video feeds let you watch everything, not just what the networks want you to see. With a little extra effort and some patience, you can explore these occasional video (o/v) channels and view live news feeds that place you right in the middle of the action.

A new generation of transportable satellite uplinks are used by global and national news organizations to transmit live on-the-scene reports back to their main TV studios. Gaining direct access to these satellite news feeds puts you on the cutting edge of worldwide developments. Several of the INTELSAT satellites often serve as effective distribution hubs for routing overseas news feeds from international and regional broadcasters either to their respective home studios or to various affiliate broadcast or cable networks in the region.

Broadcast Networks. For those rural TV viewers who live beyond the reach of terrestrial and cable TV stations, satellites provide the only effective way to receive domestic TV network programming.

General Entertainment Programming. In addition to dedicated news, sports, and movie channels, satellite broadcasters also are providing a wide variety of general entertainment programming, including pop and rock music video services and educational television.

Radio Programming. Satellites also deliver numerous audio services with programming that ranges from classical and top forty, to easy listening and heavy metal rock. News and talk radio services

also are available via satellite.

Voice and Data Traffic. In addition to transmitting TV and radio programming, satellites also are used to relay computer data at speeds of several million bits of information per second, send mail electronically, and carry private telephone and fax communications.

C-BAND SERVICES FOR LARGE DISH SATELLITE TV RECEIVING SYSTEMS

Satellite television transponders are used by regional broadcasters and cable TV programmers to instantaneously relay programs to their cable and/or broadcast TV affiliate stations within the region. National broadcast TV networks serving Australia, Thailand, Malaysia, Indonesia, the Philippines, Japan, and the People's Republic of China, also use satellite transponders to provide regular program feeds to local TV stations. Many of these regional and national satellite TV services are available to owners of large-aperture C-band satellite receiving systems.

Test Patterns. Not all satellite transponders are in use on a continual basis. When an "occasional use" transponder is not carrying a particular feed, it often displays a color bar pattern called a test pattern. These often indicate what service will be operating there, occasionally even displaying information on programming content, source location, the start-up time, and other instructions. Test patterns show that the particular transponder is performing adequately, and allow technicians the opportunity to check equipment adjustments prior to the upcoming feed. There is a wide variety of test patterns in use, many of them quite colorful.

Satellite News Feeds and Occasional Video. Additional satellite transponders are used whenever necessary to relay live and unedited versions of breaking news stories and major sporting events from remote locations back to the main network studios. These "occasional-use" feeds can be accessed by anyone with a satellite TV system. It is a common occurrence to see news commentators getting ready to feed on-the-spot news coverage back to their main studios. The technicians must have their equipment in operation prior to the actual use of the feed to insure that everything is working properly. So it is frequently possible for you to see reporters on assignment rehearsing their lines or having their makeup retouched. Satellite TV lets you go behind the scene and find out things you'll never hear on the regular programs!

The larger dish systems have instantaneous access to news information coming from the world's hot spots, often long before their local evening news broadcasts. The networks involved can lease transponder time for short periods to transfer these news feeds from one area to another. When major international news stories are occurring, many satellite transponders which are normally inactive will suddenly burst into a frenzy of video reports that will criss-cross not only the region but the world as well. Sometimes on international news feeds, the particular video may be relayed through several satellites before it reaches its final destination.

When an international news event of major significance occurs, there is a scramble by news teams all over the world to provide on-the-scene information for the folks at home. Many times

the satellite uplink facilities for transferring these programs are quite limited, so the networks form a "pool" and share them, often only changing the background drop behind the news commentator as they switch from one news source to the next.

To insure that news feeds are received perfectly, the technicians in the field will sometimes rewind and replay these short segments several times to make sure that the overseas studios have received it. That's right, when you own a large aperture satellite TV receiving system, you get to watch the news forwards and backwards!

Large businesses also are beginning to use satellite television as a means of informing their sales or management personnel on new developments with products or services. Some organizations are using satellite television as a substitute for expensive national meetings or conventions. A number of regional sites can be hooked up to a satellite, allowing people to see and hear each other. With the downward trend in satellite rental fees, *teleconferencing* has become a money-saving proposition.

The following low-powered C-band satellites provide dozens of channels of news, sports, and entertainment programming. Keep in mind, however, that reception of programming from these satellite requires the use of a large aperture antenna. Reception of more than one C-band satellite also will require the installation of a motorized antenna drive, or a multi-satellite feedhorn system.

The two-digit alpha-numeric codes which follow the names of the various satellites (A1, P2, I5, etc.) correspond to remote control keypad codes many satellite receivers use for locating the individual satellites. They also may be used in satellite program guides to identify the various satellites.

ASIASAT SATELLITES

On April 7, 1990, AsiaSat 1—the first commercial communications satellite designed for enhanced coverage of Asian countries—was launched to 105.5 degrees east longitude. This regionally-based satellite is owned by Asia Satellite Telecommunications Co. Ltd.

Formerly known as Westar VI, AsiaSat 1 initially was built by Hughes for the Western Union corporation. Westar VI was launched in 1984, but the satellite's payload assist module (PAM) failed to boost the spacecraft into a geostationary orbit. A special NASA Space Shuttle mission retrieved the satellite, it was refurbished and sold to Asia Satellite Telecommunications Co., Ltd.

AsiaSat 1 generates two regional spot beams covering most of Asia. The *northern beam* covers China, Hong Kong, Taiwan, North and South Korea, Nepal, Bangladesh, and Japan. The *southern beam* covers Thailand, Pakistan, Malaysia, Myanmar, Singapore, Vietnam, Laos, Cambodia, Afghanistan, Iran, Saudi Arabia, Kuwait, Egypt, and Israel. Neither of these beams provide coverage of Australia or New Zealand.

ASIASAT 2

Asia Satellite Telecommunications Co., Ltd. launched AsiaSat2 a new dual-band (C/Ku) satellite on November 28th1995. The more powerful AsiaSat 2 bird features expanded C-band coverage which includes much of Australia and New Zealand. STAR TV has acquired a total of eight transponders on the new satellite. The Asian programmer

C-BAND TV SATELLITES FOR ASIA, AUSTRALIA & THE PACIFIC RIM

Statsionar 5 53° E
Intelsat 507 57° E
Intelsat 602 60° E
Intelsat 604 63° E
Intelsat 704 66° E
Insat II-A 74° E
Thaicom 1 & 2 78.5° E
Statsionar 13 80° E
Insat 1D 82.9° E

Statsionar 6 (CIS) 90° East
Insat II-B 93.5° East
Statsionar 14 (CIS) 96° East

Statsionar-21 (CIS) 103° East
AsiaSat 1 [H.K.) 105.5° East
Palapa B2R (Indonesia) 108° East
Palapa B2P (Indonesia) 113° East
Chinasat 5 (PRC) 115.5° East
Palapa B4 (Indonesia) 118° East

Rimsat 1 (CIS) 130° East
Apstar 1 (H.K.) 138° East
Statsionar 7 (CIS)140° East
Rimsat 2 (CIS) 142.5 East
Statsionar 16 (CIS) 145° East

PAS-2 (PanAmSat—USA) 169° East
Intelsat 701 174° East
Intelsat 703 177° East
Intelsat 511 180° East
Intelsat 503 183° East

intends to use the additional satellite capacity to relay direct-to-home satellite TV programming to viewers equipped with antennas as small as one meter (3.28 ft.) in diameter. Additional programmers such as Deutsche Welle, Radio Television Portugal International, The Value Channel, and Associated Press International also plan to use Asiasat 2 for TV distribution purposes. The BBC will also use Asiasat2 for a digital Global Distribution System of up to 15 stereo radio services for re-broadcasters. (For further information about Asiasat 2, see Chapter 13.)

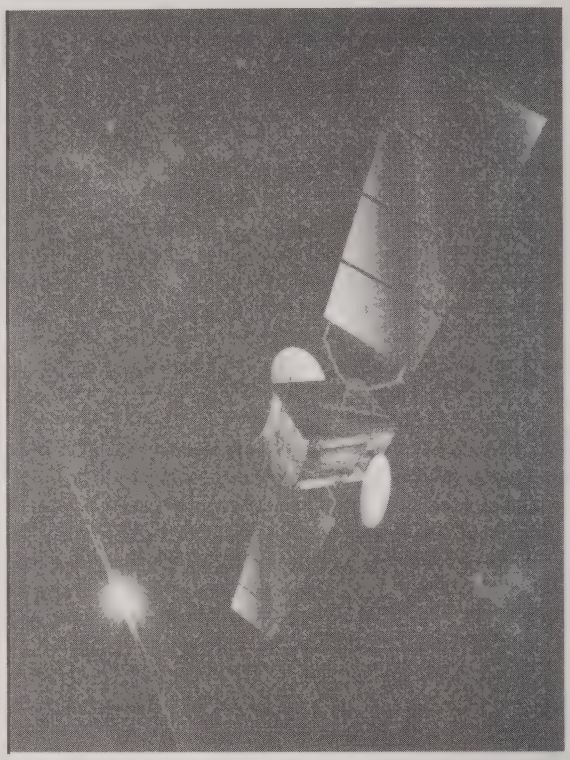


FIG. 2-5. ARTIST'S RENDITION OF THE ASIASAT 2 SATELLITE. (COURTESY ASIA SATELLITE TELECOMMUNICATIONS CO., LTD.)

STAR TV PROGRAM LINEUP

STAR TV currently uses twelve AsiaSat 1 transponders, five in the northern beam and seven in the southern beam, to transmit TV services to countries in Asia and the Middle East. With the launch of AsiaSat 2 in 1995, STAR TV will be able to transmit additional program services to locations south as well as north of the Earth's equator (see page 29).

The free-to-air STAR TV programming package now available in Asia and the Middle East includes a news service provided by the *BBC World Service Television* (southern beam only), *Channel [V]*, *Prime Sports*, the *Chinese Channel*, *Zee TV* (southern beam only) and *STAR Plus*—a general entertainment service. Originating from London, *BBC Asia* keeps viewers up-to-date on all world events. The service also provides extensive coverage of Asian news reports. Business developments and current affairs also are a regular part of the channel's continuous coverage.

Channel [V] provides the latest music videos from such international pop stars as Madonna, Mariah Carey, Michael and Janet Jackson, and Phil Collins, as well as the performances of popular Asian and Indian musical groups.

Prime Sports is Asia's first 24-hour sports channel. The channel features many popular international, American, and Asian sporting events, including live

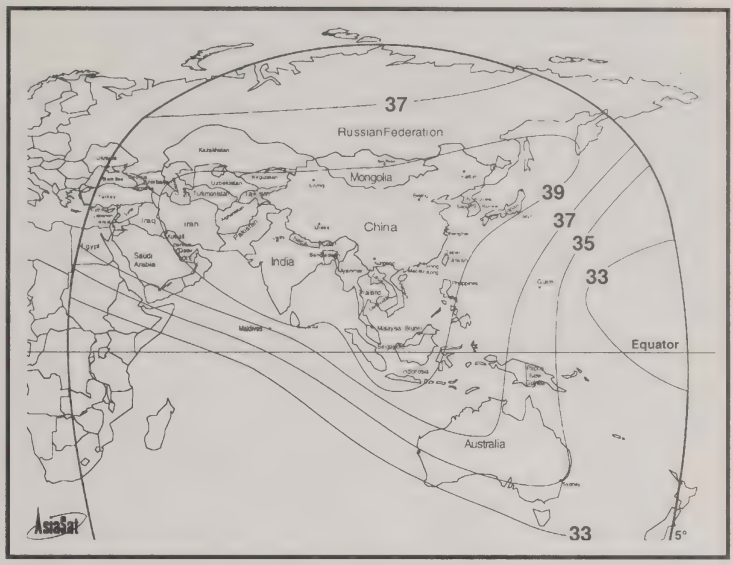


FIG.2-6. ASIASAT 2 C-BAND BEAM COVERAGE ZONE. CONTOURS IN DBW. (COURTESY ASIASAT.)

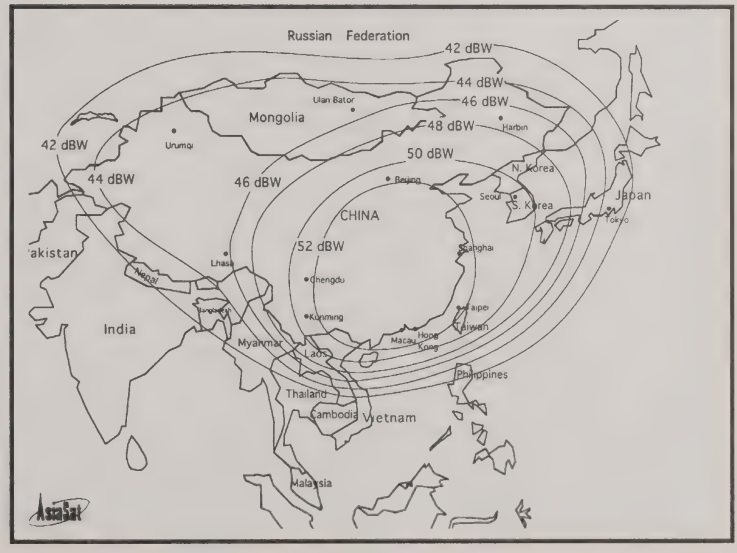


FIG.2-7. ASIASAT 2 KU-BAND BEAM COVERAGE ZONE. CONTOURS IN DBW. (COURTESY ASIASAT.)

FIG. 2-8. ASIASAT 2 CUSTOMER LIST AS OF JULY 6, 1995. (COURTESY ASIASAT.)

C-band (Regional)			
STAR TV	Hong Kong	Eight 36-MHz Trs.	Regional TV Services (digital)
Deutsche Welle	Germany	One 36-MHz Tr.	TV & Radio Service (digital)
Marconi/RPTi	Portugal	One 36-MHz Tr.	TV and Radio Service (analog)
Pacific Century Group	Hong Kong	2.5 76-MHz Trs.	Regional VSAT Service
Associated Press TV	International	0.25 36-MHz Tr.	News Video Service (digital)
World Television News	International	0.25 of 36 MHz Tr.	TV News Distribution (digital)
Time Telecom	Malaysia	0.5 of 72 MHz Tr.	Telecom Service
Ku-band (China)			
Ministry of Radio, Film & Television		Three Trs.	TV & Radio Services (digital & analog)
People's Bank of China		16.5 MHz	Private VSAT Network
Ministry of Water Resources		0.5 Tr.	Private VSAT Network
Shenzhen VSAT Satellite Comm. Co. Ltd.		2 MHz	Private VSAT Network
Beijing Gas Transmission Co.		3 MHz	Private VSAT Network
Ministry of Foreign Trade & Economic Cooperation/ Ministry of Railway/China Meteorological Admin./ Xinhua News Agency		1 Tr.	Private VSAT Network
Tesonic Satellite Networks Co. Ltd.		6.75 MHz	Private VSAT Network
China Int. Travel Service		0.25 Tr.	Private VSAT Network

satellite coverage of the U.S. Open Tennis Tournament, Ryders Cup Golf, and cricket's World Cup series.

The Chinese Channel is dedicated to airing entertainment programming for Mandarin-speaking TV viewers. Specially selected programs include action-packed dramas, comedies, Chinese language music videos, and special events.

STAR Plus, STAR TV's entertainment channel, offers blockbuster films, comedies, documentaries, and popular British and American TV series.

Zee TV is a specialty channel for India which provides general entertainment programming in English and Hindi.

STAR Movies provides pay television services for the Chinese and Indian markets using AsiaSat 1 transponders in the northern and southern beams, respectively. These services offer the very latest western films along with movies specifically selected for the Chinese and Indian cable TV markets. Reception of STAR Movies requires the use of a special receiver decoder and the payment of a subscription fee.

In March of 1995, STAR TV began providing a new pan-Asian radio service known as STAR Radio. The new advertiser-supported service delivers music programming to radio stations located throughout the AsiaSat 1 satellite's coverage area. The local radio stations then rebroadcast within their respective markets. STAR Radio can also be received by home satellite TV receiving systems.

OTHER ASIASAT 1 TV SERVICES

Additional AsiaSat 1 transponders transmit the national TV services of *Myanmar TV* Burma, Pakistan, *CCTV* and *Chinese Provincial Television* from Guizhou and Yunnan in the People's Republic of China, and *Mongol Televiz* Mongolia, as well as Germany's Deutsche Welle TV service for overseas audiences.

ASIASAT 3 PLANS

Asia Satellite Telecommunications Co., Ltd. has signed an agreement with Hughes Space and Communications In-

FIG. 2-09, 2-10, & 2-11. TV PROGRAM SERVICES ON APSTAR 1: THE CARTOON CHANNEL, STAR TV, AND CHINESE EDUCATIONAL TV.

ternational for the manufacture and in orbit delivery of a Hughes HS6011P satellite, late in 1997. From a position of 122 degrees east longitude, AsiaSat 3 will use 28 C band transponders to cover Asia, India, the Middle East, and Australia. 16 additional Ku band transponders will cover selected areas. Gallium Arsenide solar cells will generate more than 7 Kw of payload power.

APSTAR SATELLITES

Asia Pacific Satellite Company, Ltd (APSTAR). of Hong Kong operates the C-band Apstar 1 satellite located at 138 degrees east longitude. Apstar 1 coverage includes the northwestern tip of Australia. The available programming includes educational TV services *CETV 1 and 2 and CETV Shandong* for the People's Republic of China, *CNN International, TNT, MTV Asia, The Cartoon Network, Reuters TV* and *China Entertainment TV.*

APSTAR intends to launch a second satellite, Apstar 2R, by early-1997 to replace a satellite launch that failed in early 1995. Dual-band (C/Ku) Apstar 2R will have a wider C-band and Ku-band coverage beams that will provide even greater coverage of Asia.

PALAPA SATELLITES

Satellite TV viewers in Asia, Papua New Guinea, and portions of northern Australia and the South Pacific can receive TV broadcasts from Indonesia's

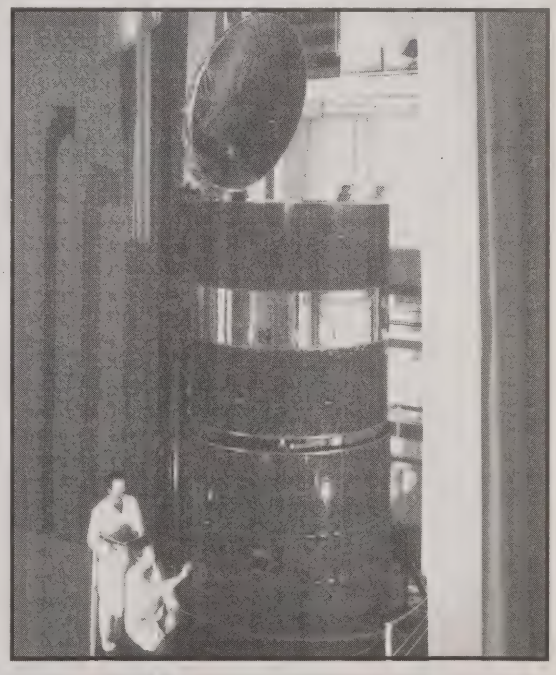


FIG.2-12. A PALAPA B SATELLITE. (COURTESY HUGHES AIRCRAFT.)

Palapa B2R, B2P and B4 satellites. The assigned orbital positions for these satellites are 108, 113, and 118 degrees east longitude, respectively.

The full-time national TV services *System Televisyan Malaysia/TV3* and *TV1* of Malaysia, *RCTI, Televisi Republic Indonesia—TVRI,* and *CPTI Educational Television* of Indonesia, and *ABS/CBN* of the Philippines are presently distributed by Palapa B satellites. What's more, the satellites handle international news exchanges on behalf of *Asiavision* and *Vis-Asia.* Best of all, international programmers such as *Canal France International, Australian Television International (ATVI), Asian Business News (ABN), STAR TV* and the U.S. *NBC* television network use Palapa B2P to relay free-to-air Asian editions of their services.

Palapa satellites also relay regional cable TV program services such as CNN International, The Discovery Channel, ESPN International and HBO in an encrypted format which renders the programming unviewable except to authorized receiving stations equipped with decoders. None of these services were available to satellite TV dish owners at the time of writing.

Palapa satellite operator Satelindo began to launch a new series of more powerful Palapa C satellites in March 1996. The Palapa C satellites feature an expanded beam coverage that includes most of Australia and New Zealand as well as the entire Asian land mass. (For further information on the Palapa C satellite system, see Chapter 13.)

THE CHINASAT-5 SATELLITE

The People's Republic of China uses the dual-band Chinasat 5 satellite located at 115.5 degrees east longitude to transmit three Chinese TV networks (CCTV 1, 2, and 3) and regional TV services (Xizang, Sichuan, Shandong, and Xinjiang TV). Chinasat 5, which was purchased by the Chinese government from U.S. satellite operator GTE Spacenet in 1993, does not provide coverage of Australia or New Zealand. Reception is limited to locations in eastern Asia.

INSAT SATELLITES

India presently operates three domestic communications satellites: Insat 1-D, Insat 2-A and Insat 2-B. The first generation Insat 1-D satellite, which is located at 82.9 degrees east longitude, carries twelve C-band (3.7 to 4.2 GHz) and two S-band (2.5 GHz) transponders. The second generation Insat 2-A and 2-B spacecraft, which are located at 74 and 93.5 degrees east longitude, each carry eighteen C-band and two S-band transponders.

Insat 2 series satellites carry a package of Indian news, sports and entertainment channels produced by Doordarshan All India Radio, as well as Doordarshan's regular broadcast TV services, which are transmitted to community receiving systems via the Insat S-band communications payload. Reception of these satellite TV services is limited to India and surrounding countries.

THE INTELSAT SATELLITE SYSTEM

In 1965, the world's first global satellite communications system was initiated by the International Telecommunications Satellite Organization (INTELSAT). With more than 125 member countries today, INTELSAT has become one of the world's most successful business cooperatives. The global organization relays communications traffic between coun-

tries, and in some instances, from one area of a country to another.

The INTELSAT system simultaneously relays thousands of telephone conversations, telegrams and telexes, and dozens of television programs. INTELSAT satellites currently handle about two-thirds of the world's overseas telephone calls and most transoceanic television.

Today, a total of eighteen INTELSAT V, V-A, VI & VII series satellites are in operation. In addition to the telephone and data channels made available, these satellites relay domestic TV services and provide capacity for international television exchanges.

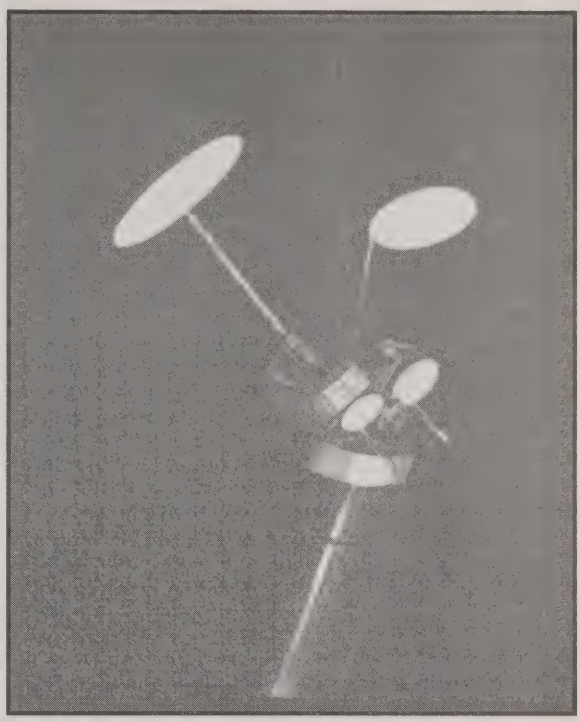


FIG. 2-13. AN INTELSAT VI SATELLITE. (COURTESY INTELSAT.)

INTELSAT also maintains several of these satellites as in-orbit spares. In the event of a satellite failure, one of these satellites can be used to reinstate regular services with a minimum amount of down-time. These spares also can be moved to other locations within the Clarke Orbit to provide new services when they are required. Capacity aboard INTELSAT's in-orbit spares is leased or purchased on a preemptible basis by various member countries to provide full-time domestic television and telephone services within their own countries.

INTELSAT regularly changes the positions of many of its satellites in order to optimize total system performance and to accommodate new countries that are leasing INTELSAT transponders for domestic and international communications use. Consequently, the satellite names which appear in the charts found elsewhere in this chapter will be continually changing.

As many as nine INTELSAT satellites can be received from locations in Asia. These satellites are positioned in clusters located over the Indian Ocean Region (IOR—57, 60, 63, and 66 degrees east longitude), the Asian Land Mass Region (ALMR—91.5 degrees East) and the Pacific Ocean Region (POR—174, 177, 180 and 183 degrees east longitude).

INTELSAT satellites in the IOR relay

the domestic TV services of Malaysia (RTM 1) and Thailand (Channels 3 and 9, Bangkok), and transmit Worldnet TV programs on behalf of the U.S. Information Agency. These satellites also transmit news and sports feeds on behalf of the world's major broadcast organizations.

INTELSAT satellites in the POR are used to transmit full-time American program services such as ESPN, NBC, CNBC, and CBS to affiliate stations in Australia, New Zealand, and Asia. These satellites transmit the domestic TV services of France (RFO France/Tahiti) relay Worldnet and American Forces Radio Television (AFRTS) programs, and handle news and sports feed on behalf of the world's major broadcast organizations.

Keep in mind that even larger antennas (typically 5 to 10 meters in diameter) must be used to obtain adequate reception of INTELSAT TV services. Many of the American TV services using the Pacific Ocean INTELSAT cluster also are encrypted to prevent unauthorized reception.

GORIZONT, EXPRESS AND GALS

Russian-built Gorizont (Russian for "horizon") and Express satellites also are extensively used within the region to relay Russian domestic television, telephone, data, and radio broadcasting signals. Russian-language television programs from the Gorizont and Express satellites located at the Russian STATSIONAR (Russian for "stationary") orbital positions of 53, 80, 90, 95, 103, and 140 degrees east longitude can be received from many locations within the Asia/Pacific Region.

Several of these satellites also are used by INTERSPUTNIK, an international satellite cooperative comprised of several European, African, and Asian nations. This cooperative relays TV and telephone communications between member countries, providing a service that is analogous to that of INTELSAT. INTERSPUTNIK also has leased transponders on several of these satellites to foreign broadcasters located in France, Portugal, India and the People's Republic of China.

In 1994, INTERSPUTNIK acquired an experimental DBS satellite known as Gals-1 from the Russian Space Agency and relocated the Ku-band spacecraft from its initial orbital assignment over Africa to a new location at 71 degrees east longitude. In October of 1994, the satellite began transmitting the Zuhdon TV Channel to Taiwan.

Rimsat, Ltd., an American company based in Fort Wayne, Indiana, also has acquired several geostationary Russian satellites capable of serving customers in the Asia/Pacific Region. Rimsat satellites located at 130 and 142.5 degrees east longitude relay several TV services which serve the growing cable TV market in India.

THE PAS SATELLITES

PanAmSat is the world's first privately-owned international satellite service provider. The U.S. corporation has operated PAS-1, a dual-band (C/Ku) international satellite for the Atlantic Ocean Region, since the late 1980s. In 1994, PanAmSat began operating a second dual-band satellite, PAS-2, at the orbital location of 169 degrees east longitude over the Pacific Ocean. PAS-2 provides wide beam C-band coverage of the Asia/Pacific region as well as Ku-band spot beam cov-

erage that targets individual areas such as China and Australia/New Zealand.

PAS-2 primarily serves as a feeder link for routing TV services from North America to Asia. Country Music Television (CMT), CNN international, ESPN International, NBC, and Prime Sports use the PAS-2 satellite with encrypted signals that prevent DTH viewing. Late additions to PAS-2 are BBC World TV an open key digital S.A. service in NTSC, along with a number of other programmers. Occasional feeds for CBS, Reuters TV, and other news organizations also appear regularly on this satellite. Australia's The Value Channel has announced plans for an analogue free to air NTSC shopping service from PAS-2.

In August of 1995, PanAmSat launched its PAS-4 satellite to the orbital location of 68.5 degrees east longitude over the Indian Ocean. Like PAS-2, PAS-4 will be a medium-powered, dual-band (C/Ku) satellite that will provide coverage of the Asia/Pacific Region via its C-band payload, and target individual markets within the region with narrowly focussed Ku-band spot beams.

THAICOM 1 & 2

Thailand's dual-band (C/Ku) Thaicom satellites, collocated at 78.5 degrees east longitude, feature a wide C-band coverage beam that stretches from Japan and eastern China in the north, to Malaysia and Indonesia in the south. In addition to transmitting several Bangkok TV channels, the Thaicom satellites also transmit TV Vietnam and TV Laos.

KU-BAND SERVICES FOR SMALL DISH SATELLITE TV SYSTEMS

Several medium and high-powered Ku-band satellites are beaming dozens of TV signals to locations throughout Asia, Australia, and the South Pacific. The coverage beams of these satellites are quite concentrated; reception therefore is limited to locations within the individual countries operating the satellites, or within bordering nations. Within their footprints, however, most of the available services can be received by antennas which are less than four feet (1.2 meters) in diameter.

All INTELSAT satellites—as well as selected Russian Gorizont and Express satellites—operating within the region also carry Ku-band satellite transponders. However, none of these satellites carried full-time Ku-band TV services at the time of writing. TV transmissions through INTELSAT and Russian Ku-band satellite capacity has heretofore been limited to the occasional exchange of news and sports programs on behalf of international and national broadcast organizations.

THE OPTUS SATELLITES

On August 27, 1985, Australia's first domestic communications spacecraft was deployed from the cargo bay of the space shuttle "Discovery". A second satellite followed on November 27, 1985, when NASA's space shuttle "Atlantis" ejected the second Hughes-built spacecraft into orbit. Launched on September 15, 1987, Optus A3—the third and last of Australia's first generation domsats—was launched. Within the past two years, two second generation Optus B satellites were launched into space by Chinese Long March rockets, replacing the first generation Optus A1 and A2 satellites which subsequently were retired from service.

KU-BAND TV SATELLITES FOR ASIA, AUSTRALIA & THE PACIFIC RIM

Gals-1 (Russia) 71° E

Thaicom 1 & 2 78.5° East

BS-3A & **BS-3B** (Japan) 110° East

JCSat 1 (Japan) 150° East
JCSat 2 (Japan) 154° East
Optus B3 (Australia) 156° East
Superbird A (Japan) 158° East
Optus B1 (Australia) 160° East
Superbird B (Japan) 162° East
Optus A3 (Australia) 164° East
PAS-2 (PanAmSat) 169° East
Intelsat 701 174° East
Intelsat 703 177° East
Intelsat 511 180° East
Intelsat 503 183° East

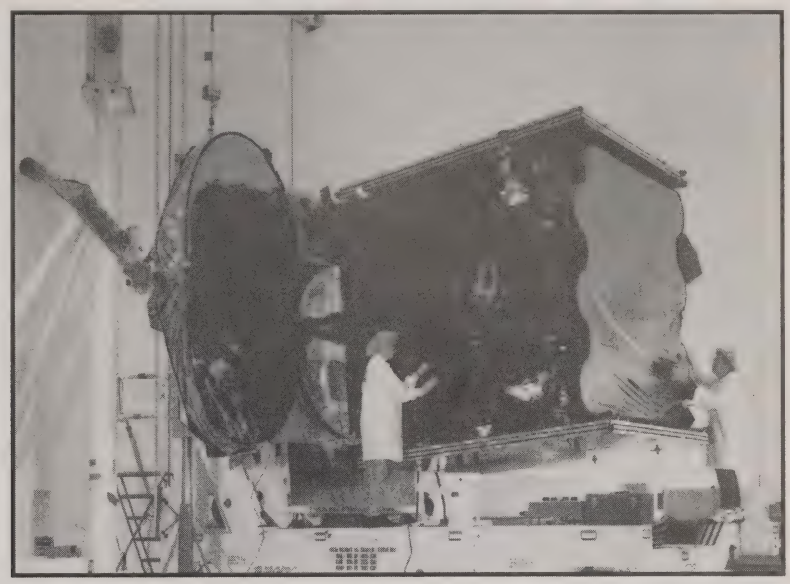


FIG.2-14. THE OPTUS B3 SATELLITE UNDERGOING TESTS PRIOR TO LAUNCH. (COURTESY HUGHES AIRCRAFT.)

Australia's Optus communications satellites, which transmit within the 12.25 ~ 12.75 GHz frequency band, carry multiple spot beams which can concentrate their signals over selected portions of Australia and New Zealand. These spot beams have long been used to deliver the television and radio services of the Australian Broadcasting Corporation (ABC) and Special Broadcasting Service (SBS), Australia's national broadcasters, as well as providing links for Australia's commercial television broadcasters. The resulting TV signals are strong enough that interference-free reception can be obtained by dishes as small as 90cm in diameter within their respective coverage zones.

The ABC's Homestead and Community Broadcasting Satellite Service (HACBSS—pronounced "hack-bus") has been joined in recent years by the Remote Community Television Services (RCTS—pronounced "R-C-T-S"). Regional television programmers such as *Golden West, Queensland Satellite TV,* and *Imparja* provide TV programming to isolated areas of Australia. These broadcasters are considered likely to migrate from B-MAC to digital DVB Compliant MPEG2 transmissions before the year 2000.

Through the advanced technology of digital video compression, a satellite transponder which previously could only carry a single TV signal can now relay ten or more TV services simultaneously, with a level of video and audio quality that actually exceeds what traditional broadcast TV transmissions could heretofore achieve.

In the past, the popularity of domestic satellite TV reception systems in Australia has largely been limited to

unserved areas of the country, where access to terrestrial TV services was either severely limited or totally unavailable.

The newest Optus B3 satellite has an even more powerful Pay TV transponder, designed to deliver multi-channel *Direct To Home (DTH)* services using digital compression technology, to dishes as small as 65cm in diameter.

In early 1995, Galaxy TV introduced an eight channel Pay TV service via Optus B1. Used largely as a feed for terrestrial *Microwave Multipoint Distribution System (MMDS)* transmitters, the B1 service has since migrated to a digitally compressed DTH service on the new Optus B3 satellite. See page 121.

In many urban areas, MMDS transmitters distribute pay TV terrestrially to homes equipped with microwave antennas and authorised receivers. A terrestrial MMDS transmitting station can theoretically cover a zone that is approximately 50 kilometers wide, although the coverage realized depends upon terrain as hills, trees, buildings, etc. block the MMDS signal.

Galaxy TV has an exclusive right to distribute pay TV via satellite in Australia until July of 1997. Galaxy may add cable operator Optus Vision's popular programming package that includes wall to wall AFL football to its B3 CDV feed later in 1996.

Substantial deregulation of the Australian cable and satellite Pay TV market is expected in July 1997. Deregulation is likely to bring a new level of competition between Pay TV broadcasters, but more importantly a broader range of program choices to home viewers. It is hoped that DTH satellite delivery of program will play a major role in these new developments. DTH satellite TV receiver/decoders using the DVB compliant MPEG2 digital standard first became available in quantity in 1996, and Australia's Galaxy TV was one of the first in the world to install these receivers. Galaxy TV's DBS service delivers noticeably better picture quality than that of their analogue MMDS service, a new standard of picture quality that is an indication of what we can expect from digital technology in future.

Optus also offers a unique national radio telephone service from the same new B3 satellite that is used for pay TV. MobileSat covers the whole of Australia and up to 200km to sea, with parts of Papua New Guinea and New Zealand, all from one L band transponder. This service has brought reliable telephone communication within reach of mobile, fixed and emergency users in remote locales who are beyond the reach of traditional hard wired and cellular telephones, at low cost.

THAICOM DTH IN THAILAND

In 1995, International Broadcasting Company (IBC) and Thai Sky of Bangkok, Thailand introduced two new Direct-To-Home (DTH) packages of digitally compressed satellite TV services to viewers throughout Thailand equipped with antennas as small as 65 centimeters in diameter. The new direct-to-home services use medium-powered Ku-band capacity on the Thaicom 1 and 2 satellites collocated at 78.5 degrees east longitude. The new Thai pay TV service provides terrestrial MMDS delivery in major urban areas and satellite delivery in rural areas. Reception of these Ku-band signals from the Thaicom satellites is

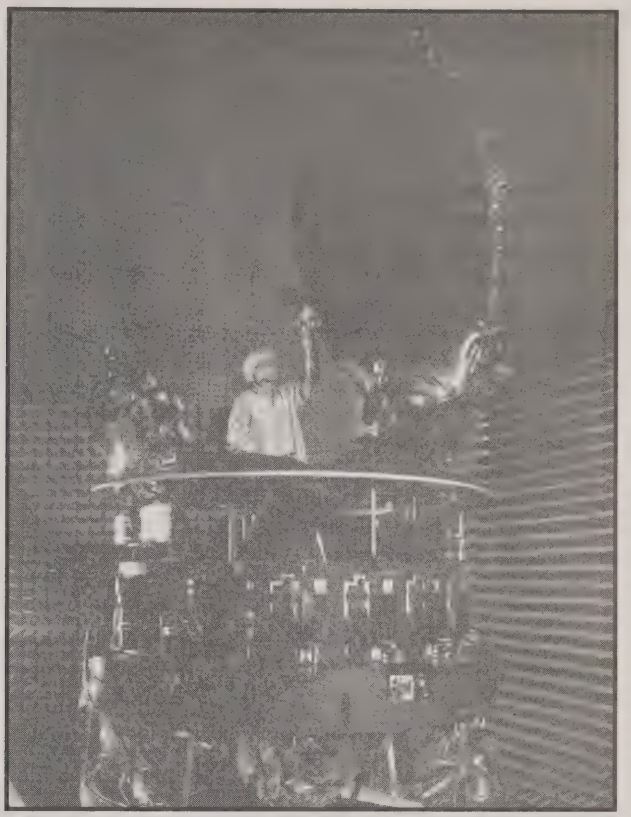


FIG.2-15. THAICOM 1 UNDERGOING TESTING. (COURTESY HUGHES AIRCRAFT.)

limited to locations in Thailand and other nearby countries in southeast Asia due to the narrow Ku-band beam coverage provided by the satellites.

THE SUPERBIRD AND JCSAT SATELLITES

The JCSat and Superbird spacecraft are medium powered Ku-band satellites which transmit video, voice, and data signals in the 12.25 ~12.75 GHz frequency band. Both satellites use highly concentrated spot beams which limit reception to the Japanese Islands.

In 1992, the government of Japan approved the use of the medium-powered Japanese JCSat and Superbird satellites for direct-to-home satellite TV broadcasting.

A total of six channels were licensed for reception by Japanese home dish owners using antennas smaller than 1 meter (3.28 feet) in diameter. On JCSat: *Japan Cable Television,* which includes programming from CNN International; *Star Channel,* a foreign film service; and *Music Television.* On Superbird: *Japan Sports Channel,* which includes programs from ESPN; music videos from *Space*

Shower; and a Japanese movie service called *Satellite Film and Drama.*

JSAT, the operator of the JCSat satellite system, launched a new, more powerful JCSat 3 satellite in August1995 that features C-band as well as Ku-band coverage beams. The new satellite has been designed to offer both domestic and regional satellite services, that include Australia and New Zealand.

BS-3A AND BS-3B DBS SATELLITES

Collocated at 110 degrees east longitude, Japan's BS-3A and BS-3B spacecraft are high-powered DBS satellites that collectively broadcast three channels of TV programming into the Japanese islands using the 11.7 ~ 12.0 GHz frequency band. Reception within mainland Japan can be obtained by antennas as small as 45 centimeters (18 inches) in diameter.

On July 4, 1987, NHK Japan Broadcasting Corporation began transmitting a bilingual 24-hour DBS service (Satellite Channel 1) with a program format that is substantially different from NHK's two terrestrial TV services. In the world news time slot, news programs produced by major broadcasting networks in several countries are presented with minimum time differential. Economic programs reporting on the state of the global economy also are presented.

Sports programs are another major feature of Satellite Channel 1. Many sports events are presented in prime time each evening. On Sundays, the entire 24 hours from the start of the day till midnight is devoted to the "Sports Special" in which sports events from the world are presented, including U.S. Major League baseball games, NFL football games, the World Cup soccer matches, boxing, and auto-racing.

On June 3, 1989, NHK expanded the coverage of Satellite Channel 2, which previously transmitted programming already offered by the terrestrial NHK TV service, to include material exclusively for satellite TV viewers. Operations also were expanded to 24-hours-a-day.

Satellite Channel 2 provides a wide range of entertainment and cultural programs with an emphasis on movies, dramas, music, and special events. About 40 percent of the programs are produced exclusively for the satellite service, with the remaining 60 percent consisting of material already broadcast terrestrially by NHK. Included is a selection of the best entertainment from overseas.

In 1991, NHK activated Satellite Channel 3, shared by Japan Satellite Broadcasting. NHK uses its transponder time to transmit up to eight hours of high definition television (HDTV) programming each day using the Hi-Vision system developed by NHK Laboratories.

FUTURE SATELLITE SYSTEMS

During the next two years, a number of additional regional and domestic satellites will be launched for the Asia/Pacific Region, ensuring additional capacity for a cornucopia of new yet-to-be-announced satellite TV services, as well as providing replacement capacity for older existing satellites. New systems previously mentioned in this chapter include the dual-band (C/Ku) Apstar 2R, AsiaSat 2, AsiaSat 3, JCSat 3, Palapa C1 and C2, PAS-4 and Thaicom 3 satellites. The good news for home satellite dish owners is that there will be an even greater number of TV channels from new satellites with stronger signals to choose from in the not too distant future.

UNDERSTANDING YOUR SATELLITE TV SYSTEM

Now that we've taken a look at the satellites and the programming that's up there, it's time to come back down to Earth and check out just what it takes to receive them. You do not have to understand the technical details of this chapter to enjoy your system. It's similar to operating your regular TV set: you don't have to know anything about the antenna or cable. It can be as simple as pushing a button corresponding to your favorite channel. But you may appreciate a simplified yet comprehensive overview of the internal workings of your system. First of all, let's take a look at a block diagram of the overall system.

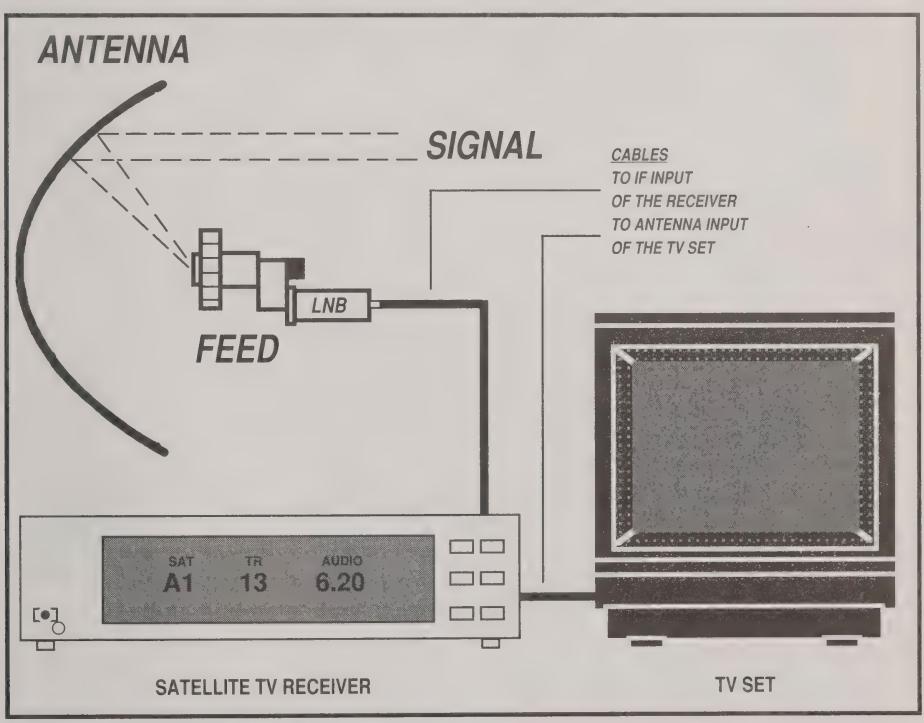


FIG.3-1. SATELLITE TV SYSTEM BLOCK DIAGRAM.

THE ANTENNA

The microwave signals transmitted by the satellites are very weak in strength when they finally arrive at your home. The dish antenna, typically 6 to 10 feet (2 to 3 meters) in diameter for C-band receiving systems, or less than 3.28 feet (1 meter) in diameter for Ku-band receiving systems, captures as much signal as possible and reflects it to a common point above the center of the dish, called the focal point. The dish antenna must be accurately pointed at the satellite in order to gather enough signal to make a picture appear on your TV screen. Being off by more than an inch or two can make the difference between a good picture or no picture at all. A metal device called the feedhorn is located at the focal point and helps to gather up the reflected microwave signals, conducting them back to the first stage of electronics with a minimal amount of signal loss.

THE LNB

The first stage of electronics is called the low noise block down-converter or LNB. It looks like a metal box with a rectangular opening in the front of it. Centered within this opening is a short metal probe less than an inch in length. This probe is the actual satellite receiving antenna which picks up the signal that's reflected off the dish and conducts it to the first electronic circuit of the LNB.

The LNB consists of two distinct stages. The LNB's initial stage is comprised of several microwave amplifier circuits, one right after the other. They multiply the incoming microwave signal of less than a millionth of a volt by a factor of 1,000,000 or more.

This amplified satellite signal is then sent on to the second stage of the LNB called the downconverter. The downconverter is a specialized electronic circuit which reduces the incoming microwave signal to a much lower frequency range, called the intermediate frequency, or "IF".

A microwave mixing circuit inside the downconverter combines the incoming satellite signal with a second signal generated by the LNB's dielectric resonant oscillator (DRO). Dielectric materials such as teflon or ceramics are used since their physical characteristics cause the circuit in which they are present to resonate at a precise frequency. The DRO is also pretty stable; this keeps your downconverter from drifting off frequency.

The DRO circuit is called an oscillator because it electronically vibrates back and forth to produce a microwave signal. When the incoming and DRO signals beat or "heterodyne" together, a signal is created that steps the entire C and Ku satellite frequency bands down to a wide block of IF frequencies ranging from 950 to 1450 MHz (or 950 to 2050 MHz for models which also are sold in Europe and Asia). This block IF signal is then filtered and amplified before being sent to the indoor receiver via a length of coaxial cable.

SATELLITE RECEIVERS

Inside the receiver, another mixer circuit, which is controlled by the unit's channel selector, is used to produce a second IF signal that contains a single satellite channel. When we say second IF, we actually mean a band of frequencies centered on a particular frequency. Some manufacturers use a 70-MHz cen-

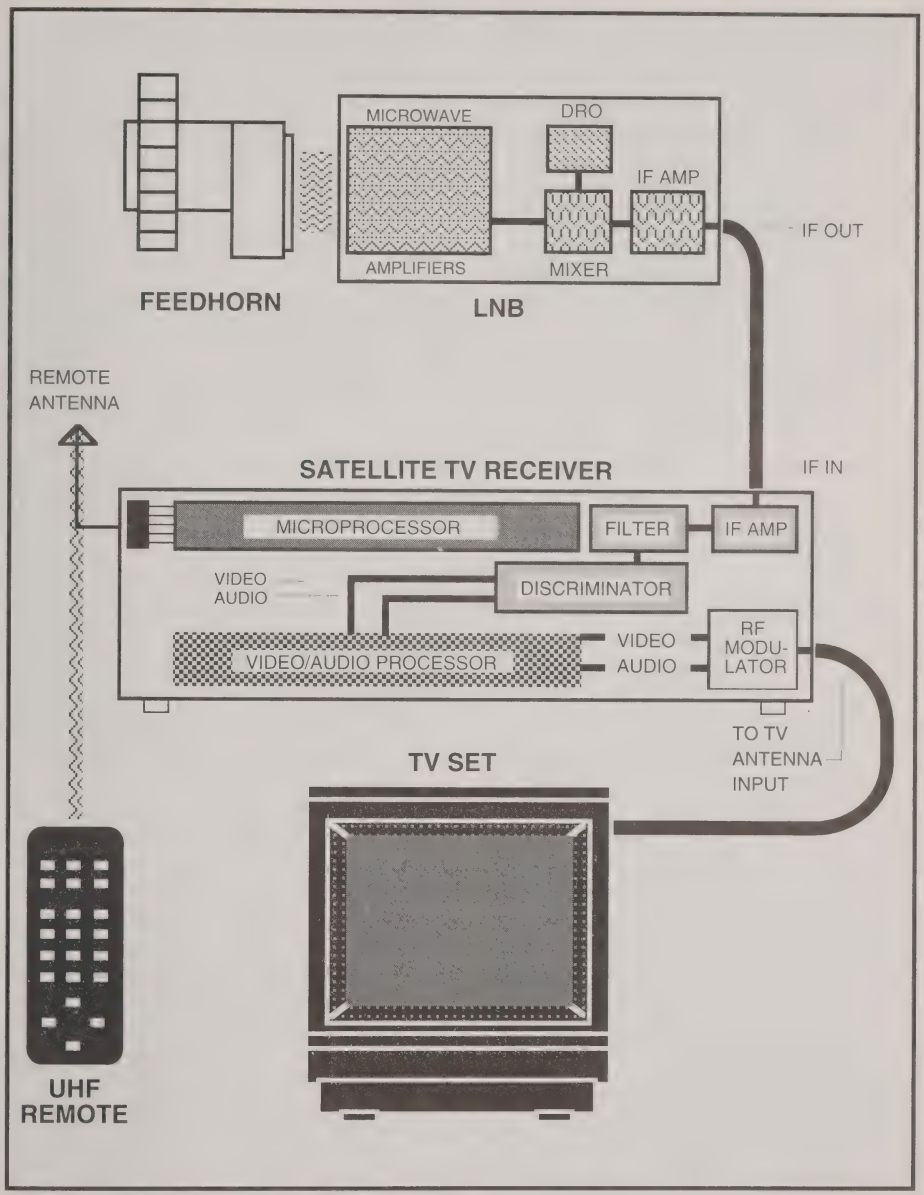


FIG.3-2. TRANSFORMATION OF SIGNAL THROUGH THE SYSTEM.

ter frequency for their second IF signals, while others may use 130-, 140-, or even 510-MHz. Some receivers provide external loop-through connections to the second IF portion of the circuitry so that filters can be added to enhance reception or suppress terrestrial interference. Other more advanced receivers contain built-in filters which can be selected by the operator on a channel-by-channel basis.

The bandwidth of the second IF signal needs to be around 27 MHz wide in order to effectively pass along the picture and sound information for one satellite TV channel. The receiver takes the second IF signal, amplifies it some more and filters it down to the 27-MHz-wide signal. Unwanted background noise which is present above and below the signal is eliminated.

After being filtered, the IF signal is fed into another circuit called a discriminator. The discriminator's job is to strip off the video and audio signals, which are contained in the second IF in the same way as they were in the original C- or Ku-band signal. We may have stepped the frequency way down in order to handle it more easily, but that doesn't affect the video or audio information at all. For this reason, the original microwave frequency is called a "carrier". After leaving the discriminator, the composite audio and video signals are separated and passed on to other circuits for processing.

Nearly every unencrypted satellite TV transmission uses a second carrier, called a "subcarrier", that is contained within the 27-MHz signal bandwidth. Subcarriers are used to carry the audio for each video program. The monaural subcarriers used by many C-band satellites are located 6.2 MHz or 6.8 MHz to one side of the center frequency.

All satellite TV receivers have a control that allows you to select the appropriate subcarriers for the desired channels. On some satellites there also may be several "auxiliary" subcarriers attached to any one TV channel.

Additional subcarriers are used to transmit broadcast radio programs or data transmissions. They do not interfere at all with the video program and offer a way to provide multiple use for these expensive satellite transponders. These additional auxiliary programs also can be received by your satellite TV receiver.

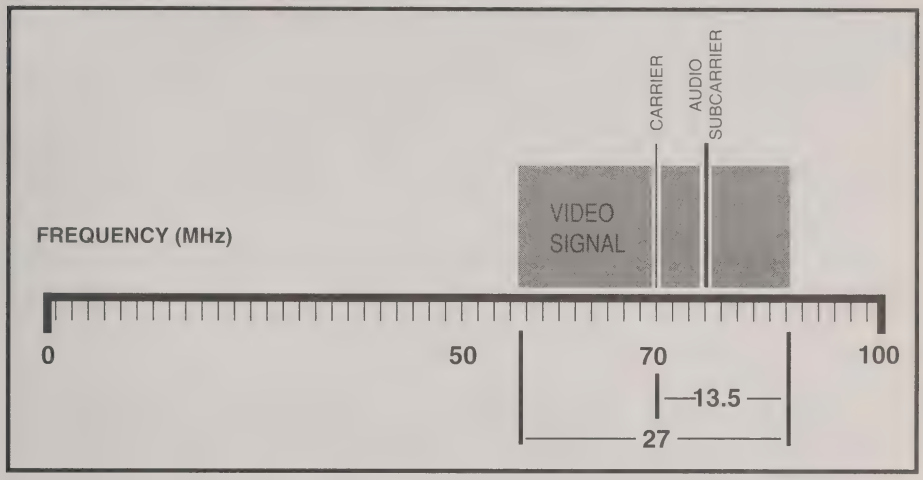
All receivers have a means of selecting which channel you want to see. Most of today's satellite receivers come with a wireless remote control for channel selection. Many models also provide an on-screen graphics display that will tell you which satellite channel you are viewing. Other channel selection features include channel up/down, direct access, scan tuning, designated "favorite" video and audio channels, and automatic fine-tuning.

DECODERS AND IRDS

Satellite receivers come in a variety of packages that range from simple utilitarian models to infinitely more complex units that integrate the receiver, decoder, and antenna positioner into a single integrated receiver/decoder or "IRD". If your system is equipped with a simple utilitarian receiver, you can add a separate decoder to gain access to subscription program services. IRDs come with a built-in decoder module which eliminates the need for a separate decoder box.

Encryption is an electronic means of

FIG.3-3. RECEIVER SECOND IF BANDWIDTH.



rendering the video and audio reception of a program unintelligible except to those stations which can reassemble the signals; all other stations intercepting the scrambled program will encounter distorted video and no audio, or in some cases, a "barker channel" that provides an audio message about how to subscribe to the encrypted program service.

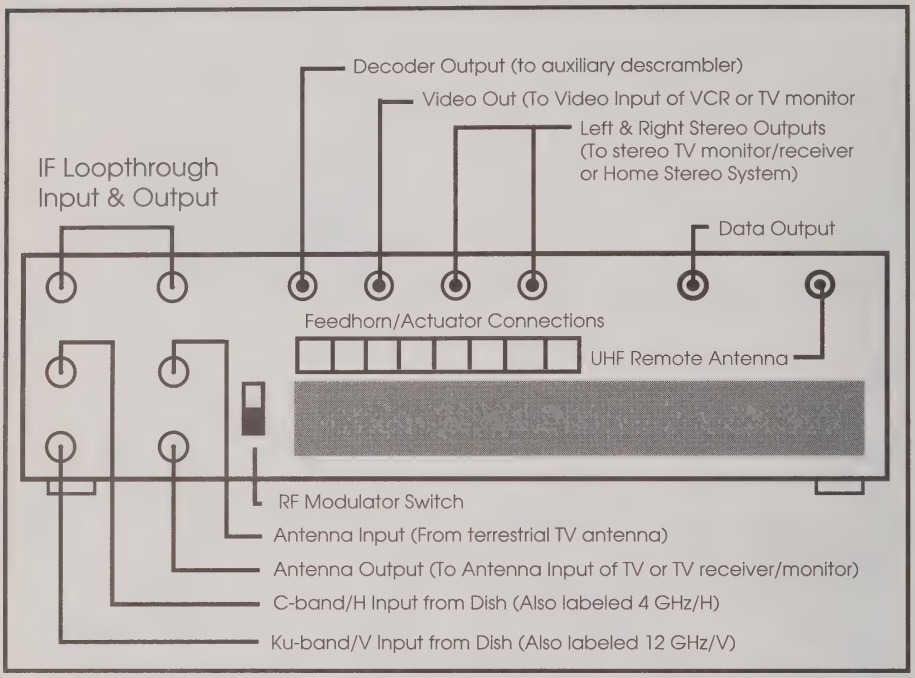
The picture commonly is secured by converting the video's standard synchronization codes to an alternate format and by distorting the video in some way. One method, for example, turns the picture inside out—thereby creating a kind of negative image.

Certain encryption systems enhance their security by slicing the video into individual blocks and then rearranging the order of these blocks. A kind of electronic "key" called an algorithm is used to control the rearrangement of the block order. Unless the descrambler has access to this key, the picture remains an unintelligible jumble.

The sound portion of the programming commonly is changed from an analog waveform to a stream of digital impulses called "bits". This conversion to digital actually improves the fidelity of the audio signals. The audio also is encrypted using an algorithm.

Encrypted program services can individually address each subscriber through the use of an authorization code that is transmitted at regular intervals over their respective satellite transponders to every home satellite TV system. This code is used to switch on-or-off each decoder module's access to the electronic keys needed before the decoder can unlock the signal and begin to separately reassemble the video and audio signals of each program service for which it has authorization. Since every subscriber's decoder can be turned on or off within minutes, this addressable technology also makes it possible for some programmers to offer special pay-per-view and pay-per-series programs. In this

FIG.3-4. AUXILIARY HOOKUPS.



case, the addressable code is switched on at the beginning of the program and then switched off again at the end of the program.

RECEIVING DIGITALLY COMPRESSED SATELLITE TV PROGRAM SERVICES

Many of the newest pay TV services coming your way via satellite are using advanced digital video compression technology to fit multiple TV signals onto a single satellite channel or transponder. With digital video compression, each program's video and audio components are converted from a standard analog waveform into a stream of numerical digits. These binary digits or bits—the zeros and ones used by today's computer logic circuitry—accurately represent in an abbreviated numerical code all of the content of the original video and audio signals.

Through digital video compression, multiple TV channels are combined or *multiplexed* into a single signal that contains all of the various programming information as well as the encryption and address codes which your satellite receiver needs to decode each of the channels that it has been authorized to receive.

When receiving standard analog encrypted satellite transmissions, your system usually will display a jumbled TV

picture that at least allows you to detect the presence of an incoming signal. This is not the case, however, when receiving digitally compressed services with an unauthorized satellite receiving system. Unless your receiver has been authorized to access a digitally compressed service, you will not be able to detect the presence of any signal at all. Even when you are tuned to the correct satellite channel frequency, the signal will appear on your TV screen as random noise and only an audio hiss will come through the TV set's speakers.

THE RF MODULATOR

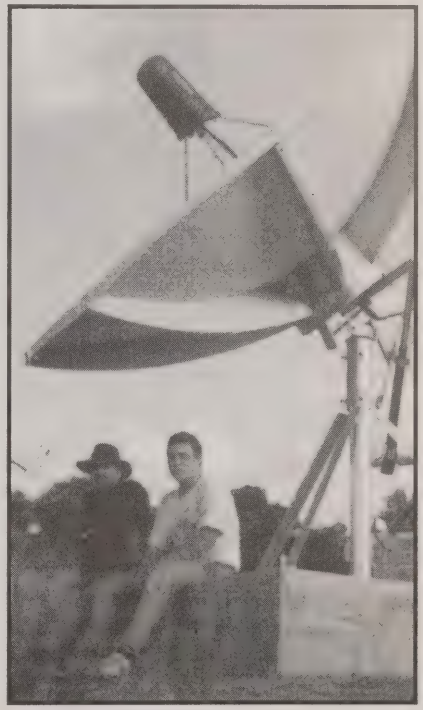
The video and audio signals are internally connected to an additional unit called the Radio Frequency (RF) modulator. The modulator acts as a miniature transmitter for a selected regular TV channel and hooks up directly to your TV's cable input, if it has one, or through a CATV transformer to your TV's antenna terminals. After selecting one of these for your satellite channel, you will still be able to receive your local broadcasts on their usual channels.

The satellite receiver also will furnish video as well as right and left audio outputs. These are useful for connecting directly to a VCR, stereo-capable TV set, or color video monitor. Whenever high fidelity or stereo audio reception is desired, the audio outputs can be connected to your home entertainment sound center.

Many satellite-delivered entertainment services offer their programs in stereo. Encrypted services may even offer digital, compact disc quality stereo with a surround sound track.

Some video perfectionists use a professional color video monitor in place of the standard television set in order to receive studio quality reception. But if you are receiving a good signal from the satellite, most modulators will give you good reception on your home television set.

FIG.3-5. "WE UNDERSTAND OUR SATELLITE TV SYSTEM IS A NICE PLACE TO SIT OUT OF THE SUN" (COURTESY MELBOURNE SATELLITE)



"BASIL'S BEEN WORKING ON HIS TAN AGAIN...AND TONIGHT IT'S WORLD CUP FOOTBALL. EVER SINCE HE GOT THE DISH THEY'VE BEEN INSEPARABLE."

SATELLITE ANTENNAS

During the past ten years, millions of giant satellite antennas have sprouted up all over the globe. Most individuals, at one time or another, have probably come across one of those giant 8- to 16-foot dishes, either in a neighbor's backyard or perhaps on the roof of a local hotel or bar. You may ask yourself: "Why does that thing have to be so big?"

Typically, satellites operating in the 3.7 to 4.2 GHz "C-band" frequency range only transmit from 8 to 16 watts of power. After traveling over 22,000 miles and being spread out over most of any continent, the satellite signals are extremely weak, almost nonexistent. The satellite companies use low power levels because the terrestrial microwave link-up which many PTTs use to criss-cross the continent operates on the same frequency band. Higher power levels would cause interference to those telephone circuits upon which we all depend.

The international INTELSAT and PanAmSat organizations as well as countries such as Australia, Thailand and Japan use medium-powered Ku-band satellites to communicate within the region or within an individual country. When used for television purposes, these Ku-band birds can supply dishes 2 to 6 feet (65 cm to 2 m) in diameter with excellent TV reception. The reason that smaller antennas can be used to receive Ku-band signals is that these medium-powered satellites transmit from 20 to 50 watts of power.

Japanese direct broadcast satellites (DBS) operate within the 11.7 to 12.0 GHz frequency band. These high-powered Ku-band satellites, which transmit using 100 watts of power per channel, can be received by tiny 18-inch antennas.

SMALL APERTURE ALUMINUM AND FIBERGLASS DISHES

Every satellite receiving dish catches the satellite's signal and reflects it back to a common point, called the focal point, thus taking a weak signal which is spread over a wide area and concentrating it, making it stronger. The performance of any type of antenna is primarily governed by the accuracy of the dish's curvature. Dishes made from any of these materials can provide equally good reception for a given size. No matter what materials are used, the dish is only as accurate as the mold and dies used to produce it. For this you will have to depend on the reputation of the manufacturer.

Solid aluminum dishes are rugged and tend to hold their exact shape over the lifetime of the system. Aluminum antennas usually are coated with a special non-reflective paint to keep sunlight from being reflected to the focal point where it

FIG.4-1. C-BAND SATELLITE ANTENNA FARM (RIGHT).

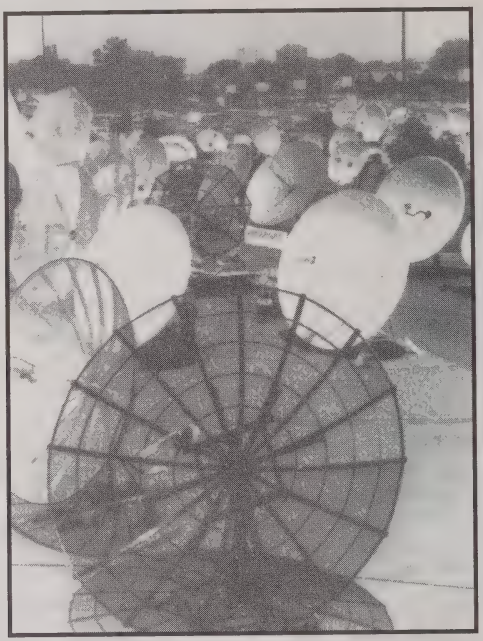


FIG.4-2. A 7.5 FT. C-BAND ANTENNA WITH QUAD FEED SUPPORT. (LEFT—COURTESY ORBITRON.)

could damage the LNB. This type of antenna usually is constructed from marine-grade aluminum which prevents corrosion. A solid antenna with a bunch of holes drilled into it to lessen its environmental impact is called a perforated antenna.

Fiberglass dishes, if well constructed, can be as good as the solid aluminum type and should work fine for direct to home (DTH) satellite reception. Most standard fiberglass dish antennas have a wire mesh embedded inside of them for reflecting the satellite signal. Without a metal reflector, the satellite microwave signals would pass straight through the fiberglass. The best fiberglass dishes are pressure-molded from fiberglass-reinforced plastic. More commonly, the fiberglass is sprayed onto the mold.

LARGE APERTURE C-BAND ANTENNAS

The expanded aluminum mesh dish currently is the most popular design used for large aperture C-band antennas, possibly because it has the least impact environmentally. Since you can see through the dish, it stands the least chance of drawing complaints from neighbors in crowded suburban areas. Mesh dishes are perhaps the most susceptible to damage from the elements. A careful inspection of the method used for fastening the screen to the support members is advisable. You can check a mesh dish for curvature inaccuracies by running your hand across its surface. Noticeable bumps or waves in the surface indicate deviation from the precise parabolic curve necessary for good performance.

Large aperture dishes can come in a single piece, or as several petals that bolt together. The one-piece dish conforms most accurately to the manufacturer's master mold, but is a problem to ship. The petal dishes are stronger, easier to transport, and one or more petals can be replaced if damaged. When examining any dish you should look at how the various petals fit together. Does the surface look continuous, with little variation from petal to petal? Keep in mind that variations in curvature of as little as a quarter of an inch can affect the performance of your system.

Warpage can be detected by standing to the side and looking across the surface of the dish. The outside edges should line up with each other. Also any two strings that run from outside edge to outside edge should touch where they cross, near the center of the dish.

PRIME FOCUS VERSUS OFFSET FED ANTENNAS

There are two main kinds of TVRO receiving antennas: the prime focus and the offset fed. Both of these designs use a parabolic curve that causes all the signal received to bounce into a common focal point in front of the antenna. The more accurate the curve, the greater the amount of signal delivered to the first electronic amplifier stage of the system's LNB.

Prime focus antennas have a focal point which is located directly at the front and center of the dish. Most feedhorn/LNB assemblies on prime focus antennas use a multi-legged support bracket that bolts onto the surface of the dish; this support bracket positions the assembly over the center of the dish at the required distance for maximum concentration of signal. A sturdy support structure is important here, since being off an inch or more can be critical. Another type of LNB/feedhorn

support is the buttonhook, which uses only one support member to position the LNB and feedhorn.

The outer parameter of a prime focus antenna is usually (but not always) circular in shape. It must be tilted upward to face the desired satellite for reception to occur. Parabolic dishes can be manually or electrically adjusted for reception of any satellite in view from your location. The feedhorn and LNB assembly mount directly above the parabolic dish, centered at the focal point of the parabolic curve for maximum signal pickup.

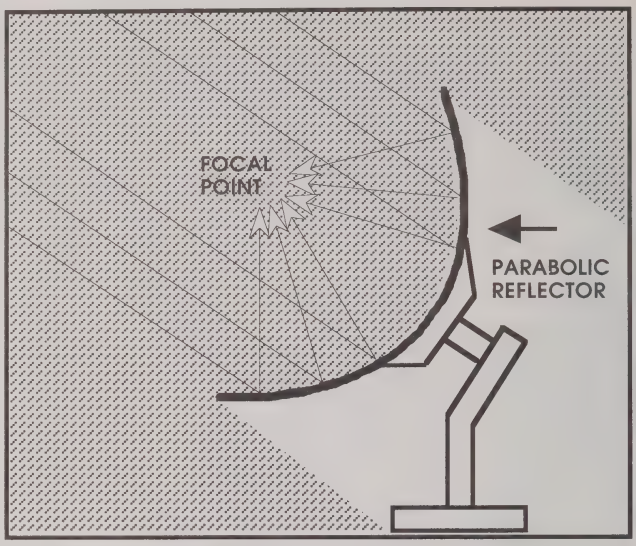


FIG.4-3. PARABOLIC RECEPTION.

Many small aperture Ku-band satellite installations used these days for direct-to-home reception use the offset fed antenna design which uses a subsection of the same parabolic curve used to produce the prime focus antenna, but one that has been selected to create a focal point that lies below the center of the reflector. One important advantage of the offset antenna is that it doesn't have to tilt upwards as high as a prime focus antenna to receive any given satellite. Rain and snow therefore tend to slide off of the offset antenna's surface rather than collect inside. This can be an important consideration for tropical climates which experience a high rain rate, or in cold climates where snow storms are a frequent occurrence. Another advantage is that the LNB and feedhorn are positioned below the front of the reflector, outside of the signal pathway between the antenna and the satellite. Since the LNB and feedhorn do not block any of the incoming signal, antenna performance is slightly enhanced.

Offset fed antennas are almost always oval rather than circular in shape, with a larger "major axis" in the north/south direction, and a smaller "minor axis" in the east/west direction. This acts to reduce the amount of signal gain produced by the antenna in the east/west plane, which results in a reduction of the amount of interference that the dish might otherwise receive from neighboring satellites to the east or west of the desired one.

FLAT ANTENNAS

Flat antennas like the Japanese model shown on the following page are being used in Japan and Europe for fixed

reception of a single satellite. Instead of using a parabolic shaped reflector to gather the incoming signals, the flat antenna uses an embedded gridwork of tiny resonant elements that receive the satellite signals and concentrate them at a common terminal point where the LNB is mounted.

FIG.4-4. AN OFFSET-FED ANTENNA. (COURTESY PRIMESTAR.)

One advantage of the flat antenna is that it is relatively unobtrusive because there is no feedhorn and the LNB mounts directly behind the antenna out of sight. This type of antenna also can be easily mounted on an outside wall or a rooftop. Flat antennas, however, are not designed to be steerable; they are most always dedicated to the reception of a single satellite or multiple satellites collocated at the same orbital position. Because of cost factors, small flat antennas are being manufactured today only for the reception of signals from higher powered Ku-band satellites.

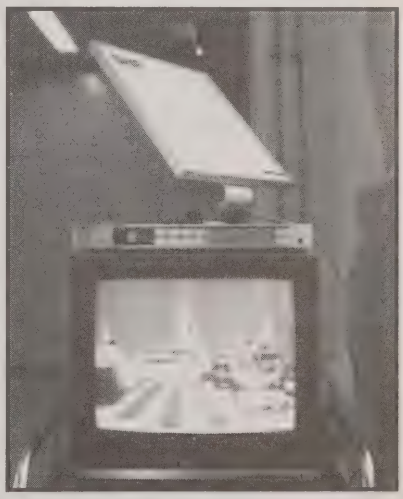


FIG.4-5. A FLAT SATELLITE ANTENNA

SPHERICAL AND CASSEGRAIN ANTENNAS

While there are other types of antennas which are used for satellite TV reception, their use is primarily limited to cable TV applications. The two alternative designs seen most often are the spherical and the cassegrain antenna.

The perimeter of a spherical antenna is usually square or rectangular in shape. The spherical antenna has a curvature which, if extended outward, would become a sphere. Unlike a parabolic dish with its single, well-defined focal point, the spherical antenna has a separate focal point for each satellite.

While the spherical antenna remains in a fixed position following installation, it can simultaneously see a large section of the available Clarke Orbit. The feedhorn/LNB assembly is mounted on an adjustable support that sits in front of the antenna. By moving the feedhorn and LNB to different focal points, satellites can be received if they are within about 20 degrees of the direction in which the antenna is pointed.

The cassegrain antenna uses a small subreflector located at the focal point of the dish to reflect the gathered signal back to the center of the reflector, where a rectangular feedhorn is mounted. The LNB attaches to a feedhorn flange located at the rear of the dish, which makes servicing the LNB an easier proposition.

For large aperture antennas with a diameter of 5 meters (m) or more, the cassegrain design achieves a slightly higher performance level than a prime focus antenna of equivalent size. However, the higher cost of manufacturing, installing and adjusting the subreflector—which has extremely tight tolerances—make it an expensive proposition for direct-to-home applications. The performance gains when used on antennas smaller than 5 m in diameter are too small to make its use attractive for home TVRO applications.

FIG.4-6. "THAT'S RIGHT FOLKS! A LITTLE EXTRA GAIN AND YOU'LL BE WATCHING MORE SATELLITE TV CHANNELS THAN YOU CAN SHAKE A STICK AT. TRUST ME ON THIS ONE!"

ANTENNA GAIN

The performance of a dish antenna is most commonly rated in terms of gain, a measurement of the amplification that a dish gives to the received signal. Quite simply put, the bigger the dish, the

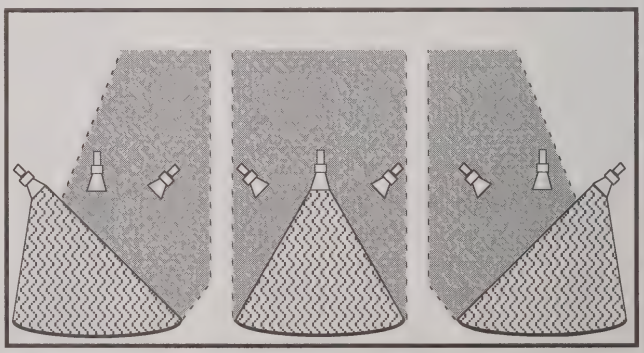


FIG.4-7. SPHERICAL ANTENNA RECEPTION.

larger the capture area and the higher the gain. Gain is expressed in deciBels, or dB.

Dish gain measurements are made in reference to a standard isotropic antenna. This is an imaginary aerial conceived by engineers which receives signals equally from all directions at once and has a gain of 0 dB. Real-life antennas are measured by determining how many times better they are than the isotropic standard.

The curvature of the dish acts much like a lens to concentrate the signal within a narrow corridor, called the "boresight". This area lies directly to the front and center of the antenna and is obtained through maximizing the signal

FIG. 4-8. A PARABOLIC REFLECTOR.

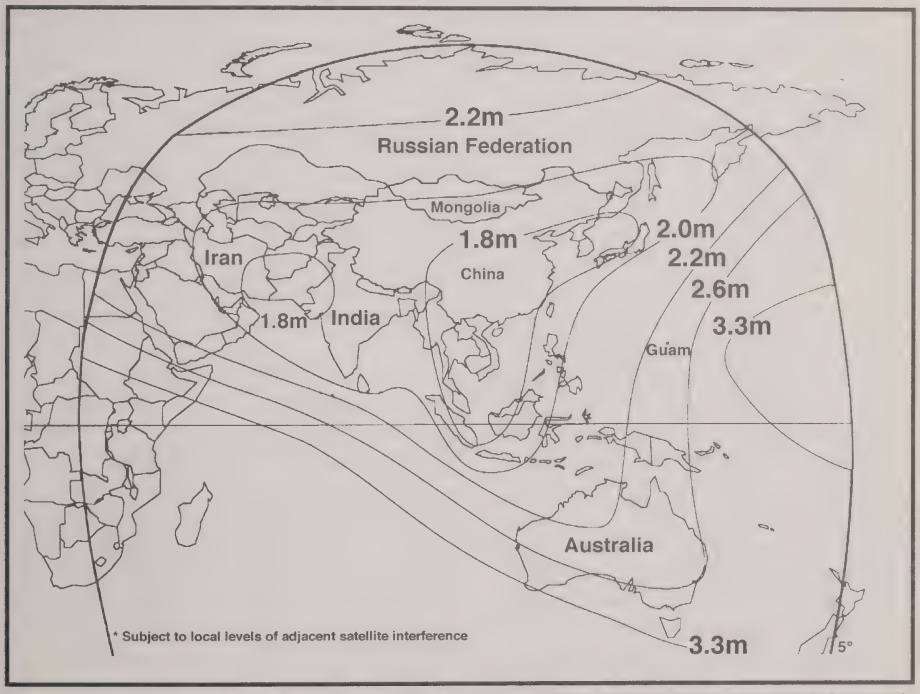


FIG.4-9. ASIASAT 2 C-BAND BEAM COVERAGE SHOWING THE RECOMMENDED ANTENNA SIZES. (COURTESY ASIASAT.)

present in the boresight, while limiting signals or noise coming from other directions. The amount of signal delivered by the dish is critical since the LNB can only amplify as much signal as it receives.

> 3 dB = a doubling of power;
> 10 dB = x 10;
> 20 dB = x 100
> 30 dB = x 1,000;
> 40 dB = x 10,000;
> 50 dB = x 100,000.

The following chart provides a list of typical gain figures for a variety of dish sizes. Sometimes manufacturers obtain slightly higher gain figures by improving the dish's efficiency, either through the use of tighter curvature tolerances or alternate feed techniques. From this chart we also can see that the gain of the antenna varies according to the frequency being received.

FIG.4-10. DISH SIZE VERSUS GAIN CHART

Size	Size	C-Band (3.7~4.2 GHz) Efficiency (%)		Ku-Band (12.25~12.75 GHz) Efficiency (%)	
in ft.	in m.	55%	70%	55%	70%
1	0.30	19.4†	20.5	29.4	30.1
2	0.61	25.4	26.5	35.4	36.1
3	0.91	29.0	30.0	38.9	39.6
4	1.22	31.5	32.5	41.4	42.1
5	1.52	33.4	34.4	43.4	44.1
6	1.82	35.0	36.0	45.0	46.0
7	2.13	36.3	37.4	46.3	47.3
8	2.43	37.5	38.5	47.4	48.5
9	2.74	38.5	39.5	48.4	49.5
10	3.05	39.4	40.5	49.4	50.4
11	3.35	40.2	41.3	50.2	51.3
12	3.65	41.0	42.0	50.9	52.0
13	3.96	41.7	42.7	51.7	52.7
16	4.87	43.5	44.5	53.5	54.5
20	6.09	45.4	46.5	55.4	56.5
25	7.62	47.4	48.4	57.3	58.4

† in dBi —gain in decibels referenced to an isotropic antenna.

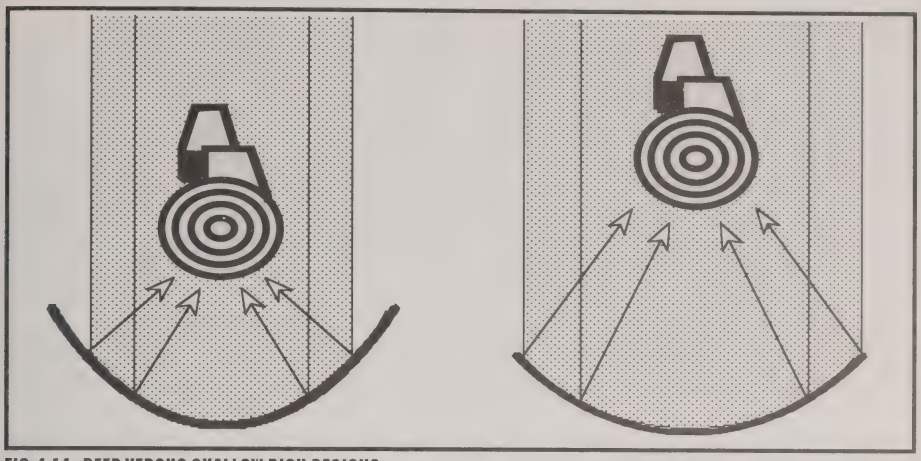


FIG.4-11. DEEP VERSUS SHALLOW DISH DESIGNS.

DEEP VERSUS SHALLOW DISHES

Depending on the parabolic curvature selected by the antenna designer, the depth of any dish can vary between extremely shallow to very deep. A shallow dish will have a very long focal distance, so the feedhorn and LNB will sit out quite a distance from the center of the antenna. The shallow dish design maximizes the potential gain of the antenna, since the feedhorn has an excellent view of the entire surface area from its lofty perch.

There are certain disadvantages to a shallow dish design, however. The molecular motion of the earth itself generates a random noise pattern within the same band of frequencies used by the satellites. This noise can combine with incoming satellite signals and degrade their reception. The shallow parabolic antenna will intercept more of this noise when it is positioned at low elevation angles than a deeper dish would. The long focal length required by a shallow dish design positions the feedhorn far above the antenna; this minimizes the potential shielding effect provided by the metal surface of the dish. An earth station using a shallow dish will be particularly vulnerable to interference created by PTT-owned microwave relay stations. This can be a consideration when the earth station is to be located in an urban environment where the possibility of encountering terrestrial interference is quite high.

With a deep dish design, the LNB and feedhorn are positioned at a level almost parallel with the rim of the antenna. The deep dish provides superior shielding for the feedhorn and LNB, rejecting more Earth noise and terrestrial interference than a shallow antenna could. But because of the feed's close proximity to the surface of the antenna, it cannot view the entire surface as well as when a shallow parabolic design is used. Consequently, the deep dish will introduce less noise into the LNB, but not provide as much gain as that produced by a shallow antenna of the same diameter.

THE f/D RATIO

The relative depth or shallowness of any antenna is often expressed as the focal length to diameter (f/D) ratio of the dish. Deep dishes have an f/D of .25 to .35, while the f/D of shallow dishes will range between .4 and .5. Most antenna manufacturers use the middle range of .36 to .375 f/D. If you know what the f/D of the antenna is, you can determine the correct focal length—the distance between the mouth of the feedhorn and the center of the surface of the dish—by multiplying the diameter of the antenna by its f/D ratio.

The smallest practical dish size for receiving some C-band video transponders would be 4 feet in diameter. It would only function in the hottest signal area of any satellite's footprint in combination with a very good LNB. Even then, sparkle-free reception would only be possible on the strongest satellite transponders. We have seen effective demonstrations of this in Thailand. A city or apartment dweller might consider this option. But a six to eight-foot dish is a good rock-bottom minimum, depending on your location. The satellite signal gets progressively weaker for locations further away from the center of the footprint. Out on the edges the larger, higher gain antennas must be used to obtain the same results.

For locations within the Asian continent, the footprint map (page 55) illustrates the minimum recommended dish sizes for sparkle-free brilliant reception of the Asiasat 2 satellite within view of any given location. Satellite effective isotropic radiated power (EIRP) levels usually expressed in deciBels above one watt of power (dBW) already have been translated into dish sizes. A margin factor has been added to allow for decreased power levels as the satellite ages.

If you plan on viewing more than just the Asiasat 2 satellite, if you must use a small dish because of space limitations, or if you live in a fringe reception area, refer to the table on page 59 and the coverage maps in Appendix A to calculate the right antenna size for any satellite available from the site location.

ANTENNA SIDE LOBE REJECTION

The perfect parabolic antenna would only amplify the satellite that is located directly to the front and center of the dish, while totally rejecting signals coming from all other directions. In reality, every antenna has its own unique receiving pattern which illustrates how much gain will be given to signals emanating from any direction. When a manufacturer specifies the gain of his antenna he is referring to the amplification provided by the " main beamwidth" of the receiving pattern which lies to the front and center of the dish. However, all antennas generate "sidelobes" which can amplify signals that are several degrees to either side of the main beam. The gain of these sidelobes must be kept -12 to -15 dB below that of the main lobe to prevent signals from an adjacent satellite from causing noticeable interference to some of the TV services that you'll want to view.

Closer spacing between satellites is becoming more and more common in the region. Moreover, newer satellites are transmitting at higher power levels than ever before. Both of these developments make antenna performance an important consideration. A small dish will generate a wide main beam that can receive more than one satellite at the

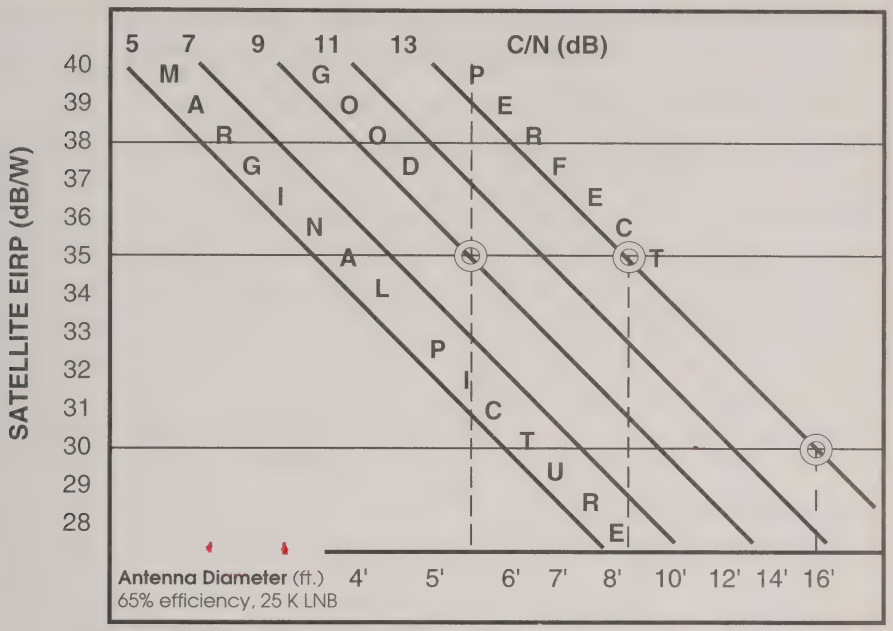
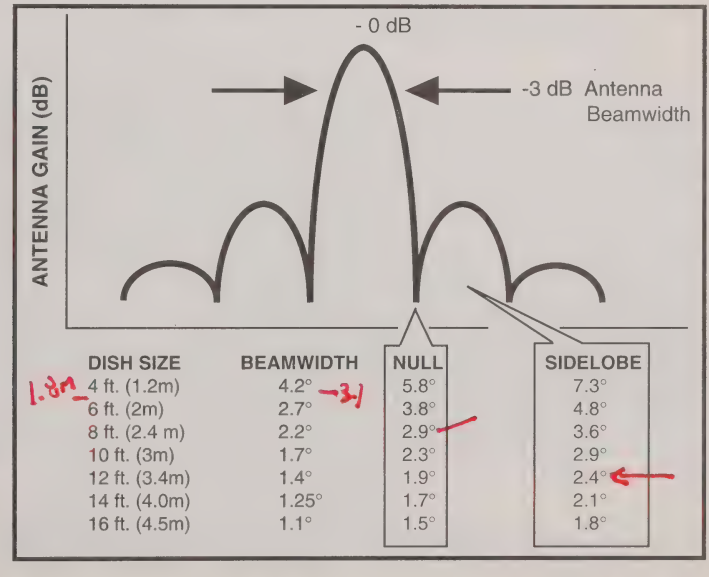


FIG.4-12. ANTENNA SIZE VERSUS PERFORMANCE. (COURTESY TAYLOR HOWARD, CHAPARRAL COMM.)

1.5 = .8



DISH SIZE	BEAMWIDTH	NULL	SIDELOBE
4 ft. (1.2m)	4.2°	5.8°	7.3°
6 ft. (2m)	2.7°	3.8°	4.8°
8 ft. (2.4 m)	2.2°	2.9°	3.6°
10 ft. (3m)	1.7°	2.3°	2.9°
12 ft. (3.4m)	1.4°	1.9°	2.4°
14 ft. (4.0m)	1.25°	1.7°	2.1°
16 ft. (4.5m)	1.1°	1.5°	1.8°

1.8m

FIG.4-13. ANTENNA MAIN BEAMWIDTH, NULL AND SIDELOBES. (COURTESY TAYLOR HOWARD, CHAPARRAL COMM.)

same time. This will result in interference to the desired TV program. For example, a 1.2m C-band antenna has a main beamwidth of 4.2 degrees, which means that it can receive three satellites within its main beam when the satellites are only separated by two degrees. Two degree spacing between satellites currently is the norm in the U.S. In the Asia/Pacific Region, however, most satellites have three or more degrees of separation between them. Due to growing demand for satellite capacity in the region, however, many additional satellites will be launched in the years ahead and closer satellite spacing is therefore inevitable.

The main exception in Asia today is the close, 2.5 degree spacing between Asiasat 1 at 105.5 degrees east longitude and the Statsionar 21 satellite located at 103 degrees east longitude. Small aperture antennas of 2m or less often experience interference problems on certain transponders. These problems appear as picture ghosting and partial lines and a

Construction:	4 piece preassembled, 12 aluminum ribs, Ku-band mesh, powder coat finish
Diameter (in feet/meters):	10 ft/3m
Frequency Range:	3.65 to 4.18 GHz (Rimsat & Express) 3.7 to 4.2 GHz (Asiasat, Palapa, & INTELSAT) 11.7 to 12.0 GHz (BS-3A & BS-3B) 12.25 to 12.75 GHz (Optus, PAS, JCSat, Superbird, & Thaicom).
Antennas Gain in dB	
at 4 GHz:	40.5 dB at 70% efficiency
at 12 GHz:	49 dB at 55% efficiency

(The gain of any antenna will vary slightly depending on the frequency: the higher the frequency, the higher the gain.)

Feed:	Prime focus, quad support
f/D Ratio:	.375 *(Focal length to antenna diameter ratio.)*
Focal Point:	45"
Side Lobes:	20dB down
Operational Winds:	60 mph

(How high a wind speed the dish can operate under without significant picture degradation.)

Survival Winds:	120 mph
(The speed beyond which damage to the dish will be likely to occur.)	
Mount:	Horizon to Horizon Polar
Azimuth Tracking Range:	180° Azimuth adjust
Elevation Adjust:	5° to 90°
(The dish can be pointed at any satellite that lies within these elevations at your location.	
Pole Size Required:	3.5" O.D.
Shipping weight:	160 lbs.

buzzing sound in the audio. The best way to solve this problem is by installing an antenna that is large enough to put the adjacent satellites in the first "null" of the antenna receiving pattern (see page 59) or place the adjacent satellite at least -18 dB down from the peak of the main beam.

DISH SPECIFICATIONS

The preceding chart which begins on page 60 shows some typical dish specifications that you might encounter when evaluating large aperture C-band antennas.

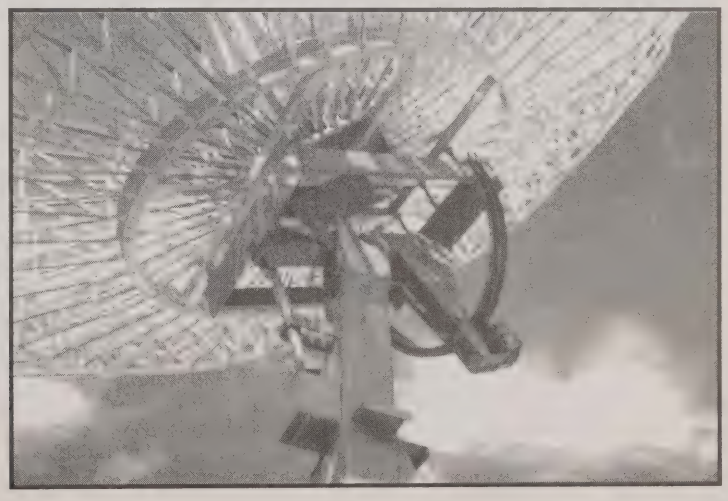


FIG.4-14. POLAR MOUNT WITH HORIZON TO HORIZON MOTOR DRIVE. (COURTESY HERO COMMUNICATIONS.)

MOUNTS

The mount is often the most overlooked aspect of any parabolic antenna. The steel mount and the support bearing which holds the dish are very important since they not only carry the full weight of the dish but must also maintain a precise position once sighted onto a satellite. Changes in alignment as small as a couple of inches can make the difference between a good picture and no picture at all. One good test for any antenna's mount is to grab the rim of the dish and shake it. If the dish support has a significant amount of looseness or "slop" in it, the wind and rain will be able to shove the dish about, which will cause erratic reception at times.

Since the height in the sky and the direction of each satellite is different, any mount used must incorporate adjustments within its structure to allow the dish to be focussed on the satellite of your choice. There are three main kinds of mounts used for parabolic dish antennas: polar, el/az, and a fixed mount which receives signals from a single satellite.

POLAR MOUNTS

Astronomers have used the polar mount for a long time because it allows their large telescopes to track stars as the earth rotates. With a polar mount, the dish antenna rotates in an arc which mimics the curvature of the Clarke Orbit. The axis of the polar mount must be installed so that it faces true north (south for stations north of the equator). Once the antenna and mount have been properly installed, the polar mount antenna can track all other satellites within view of the dish by means of a single adjustment in direction (called the azimuth). The antenna's elevation will automatically change as the dish moves east or west.

For exact tracking of the Clarke Orbit from the eastern to the western horizons, an additional adjustment called the declination must be included on the mount. The amount of declination required at any location will vary and it must be set correctly during the initial installation of the dish and mount in order for the antenna to properly track the entire portion of the geostationary satellite arc that is visible from the site location.

EL/AZ MOUNTS

Commonly encountered in commercial rather than home satellite TV systems, the el/az mount requires the independent adjustment of both the elevation and azimuth in order to receive any particular satellite. Since it requires two adjustments in order to switch satellites, it is not easy to manually maneuver. Once you have done it a few times, it will not be a very difficult procedure. El/az mounts can also be adapted for remote control with the addition of two separate electric motors.

FEEDHORNS, LNBS & POLARIZERS

16.5

The parabolic dish is the most visible portion of any earth station's antenna system. But it is really nothing more than a reflector that concentrates the satellite signal. Once the concentrated signal has been delivered to the focal point, it must be collected and passed on to the low noise amplifier with a minimum of signal loss. This is the function of the feedhorn, which bolts directly onto the mouth of the LNB.

FEEDHORNS

In the early days of home satellite reception, all antennas used a rectangular feedhorn to collect the signal. Experimentation, however, showed that a circular feed was more efficient, providing up to an additional +1 dB of gain. This makes a lot of sense when you consider that most parabolic dish antennas are themselves circular.

The most common type of feedhorn manufactured today is the scalar feed, in which a series of concentric rings gathers the signal from the outer edges of the focal point and directs them into the center of the feed. Most of the signal picked up by the feedhorn is reflected by the inner 70% of the dish's surface. The scalar feedhorn is designed to maximize its "view" of this area, while attenuating by 10 to 15 dB the signal contribution from the edges of the dish.

The molecular action of the earth itself generates random noise within the frequency bands used for satellite commu-

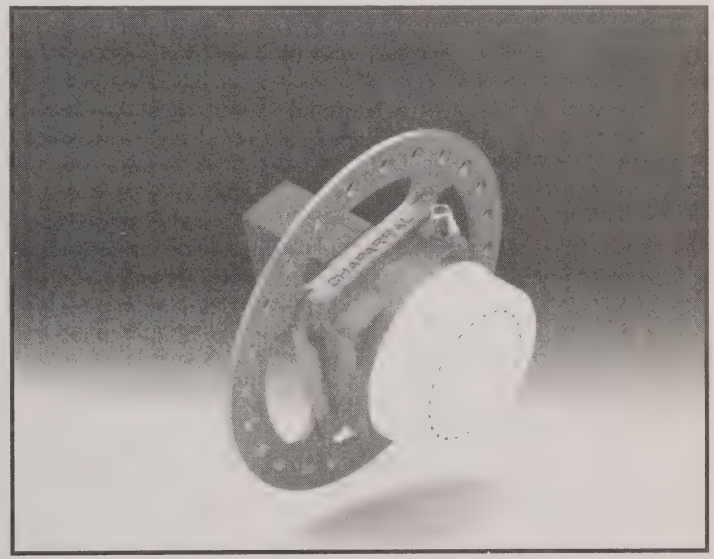


FIG.5-1. A MICROPAK C-BAND FEEDHORN. (COURTESY CHAPARRAL COMMUNICATIONS.)

nications. This random noise is many times stronger than the satellite signals reaching your location. The 10 to 15 dB of attenuation reduces the system's reception of noise generated by the portion of the Earth which lies beyond the edge of the antenna. The outer 30 percent of most dishes acts more as an Earth shield for the feedhorn than as a contributor to the overall gain of the antenna.

For optimum performance, the feed must be matched to the type of antenna that has been selected. Shallow dishes perform best with any standard feed system, while deep dishes may require a special feed or an adapter ring which lengthens the feed opening slightly. Moreover, offset-fed antennas require a special feedhorn that is matched to the performance of the reflector.

The actual length of the feed opening or "mouth" is directly related to the f/D ratio of the particular antenna. Feeds are available that have adjustable scalar plates which allow the unit to be manually tuned for best results. Ku-band antenna systems purchased in Australia will most likely come with a matching feedhorn and Low Noise Block Downconverter or LNB.

LOW NOISE BLOCK DOWNCONVERTERS

Once the concentrated satellite signal is funneled down inside the feedhorn, it encounters the first stage of electronic amplification: the LNB. Within the mouth of the LNB there is a short metal probe less than an inch long. This is the actual resonant antenna, which directly couples the signal to the first stage of electronic amplification.

A certain amount of noise will be generated within any electronic circuit. Any noise created by the LNB circuitry itself will be amplified and passed on to succeeding stages; for best performance, this noise must be kept to a minimum. Several years ago satellite TV systems needed much larger dishes to counteract the high noise generated in early low noise amplifiers. But with breakthroughs in Gallium Arsenide (GaAs) semiconductor and High Electron Mobility Transistor (HEMT) technologies, it is now possible to minimize the "noise temperature" of the LNB, and bring the cost of the product down to affordable levels as well.

KU-BAND LNBS

Ku-band LNB noise performance is expressed as a "noise figure". This is a rating, expressed in dB, which is directly derived from the noise temperature of the amplifier. Page right is a chart that shows the equivalent noise figures for most standard Ku-band LNBs.

FIG. 5-2. A KU "WIDEBAND" LNB (COURTESY CHAPARRAL COMMUNICATIONS.)

170° = 2.01 dB noise figure
150° = 1.82 dB noise figure
120° = 1.51 dB noise figure
100° = 1.29 dB noise figure
80° = 1.06 dB noise figure
60° = 0.82 dB noise figure

In Australia today, the 12.25 to 12.75 GHz Ku-band frequency range is used by the Optus B satellites for domestic TV transmissions and by the PAS-2 satellite for regional TV transmissions. Other Ku-band frequencies, such as the 10.95 to 11.70 GHz and 11.70 to 12.20 GHz spectrums, are used by other regional and domestic satellites serving the Asia/Pacific Region. Care should be taken to ensure that the LNB used with your satellite receiving system matches the correct band for the desired satellite or satellites.

C-BAND LNBS

In many parts of the Asia/Pacific region—where Ku-band signals either are unavailable, or where available do not carry all of the desired program services—C-band LNBs are used to receive satellite TV programs from Asiasat, Apstar, Palapa, INTELSAT, PAS, and Chinasat satellites. Many satellite system owners elect to install *dual-band* receiving systems to pick up both Ku- and C-band satellite TV signals.

C-band LNB noise *temperature* is expressed in degrees Kelvin (K). The lower the temperature, the less noise introduced into the LNB by its own circuitry. These LNBs generally are in the 50 to 60 K temperature range, although values down to as low as 20 K are now commonly available.

LNB/DISH TRADE-OFFS

Approximately 0.6 dB of gain is added to the dish for every 20 K drop in C-band LNB noise temperature. For some installations, a 0.5 to 1 dB improvement could make the reception sparkle-free, and the installation location may not allow a larger dish antenna. Many different combinations are possible for good reception, but not all are affordable.

Another point to consider is the amount of amplification given to the received

KU-BAND SATELLITE FREQUENCY SPECTRUMS — ASIA/PACIFIC REGION

PALAPA C/INTELSAT	10.95 TO 11.70 GHz	10.95 TO 11.70 GHz
RIMSAT E SERIES	11.50 TO 11.60 GHz	
CHINASAT 5	11.70 TO 12.20 GHz	11.70 TO 12.20 GHz
BS-3 (JAPAN)	11.75 TO 11.95 GHz	
ASIASAT 2	12.20 TO 12.50 GHz	
OPTUS B/PAS-2/APSTAR 2/PAS-4	12.25 TO 12.75 GHz	12.20 TO 12.75 GHz
THAICOM	12.50 TO 12.60 GHz	

satellite signal. This is also measured in dB. Generally, consumer LNBs have 50 to 60 dB of gain, multiplying the received signal by as much as 1,000,000 times. This provides the receiver with the necessary amount of amplification for efficient operation. In most cases, the gain figure itself matters less than the LNB's noise contribution.

LINEAR POLARIZATION

The signals transmitted by domestic satellites such as Optus and Palapa are sent by an onboard dish antenna that positions the microwave energy in either a relatively vertical (straight up and down) or horizontal (lying flat) polarization. For best reception of these signals, the LNB's antenna probe must be oriented in the same plane—horizontal or vertical—as that of the desired transponder. If the orientation of the LNB's antenna probe is not exactly matched to the satellite transponder's polarization, some of the signal will be lost. If the wrong polarization is selected for a particular transponder, you won't receive any signal at all. A slight adjustment of polarity is usually necessary when you switch from bird to bird. The amount of variance from satellite to satellite is referred to as "skew".

CIRCULAR POLARIZATION

The INTELSAT and STATSIONAR satellites use an alternate polarization format known as "circular polarization". For the best possible reception of circularly polarized satellite transmissions, you will need to use a feedhorn that has been constructed to receive these signals.

Instead of beaming the microwave energy along a "linear" plane, whether vertical or horizontal, circular polarization is transmitted in a helically rotating pattern, with right-hand circular rotating in a clockwise direction as seen from the satellite, and left-hand circular signals rotating in a counterclockwise direction. Although standard linear feedhorns can still pick up any circular polarized signal, half of the available signal power will be lost. There are several manufacturers that offer special feedhorns that can receive both the linear and circular polarization formats.

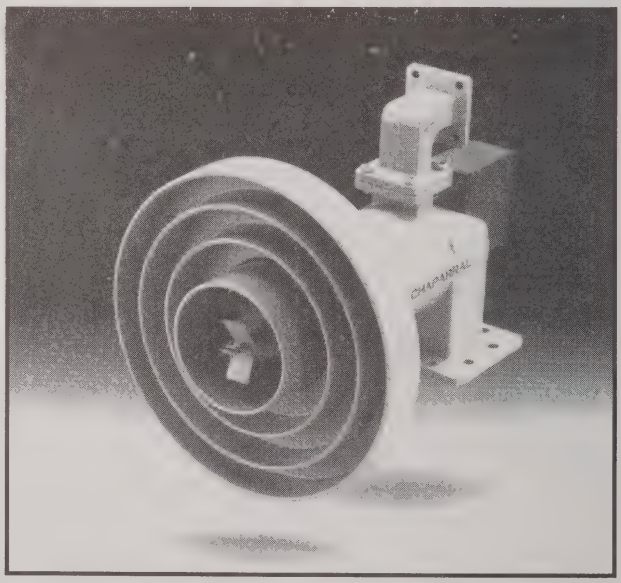


FIG.5-3. DUAL-BAND FEEDHORN. (COURTESY CHAPARRAL COMMUNICATIONS.)

FIG.5-4. LINEAR POLARIZATION.

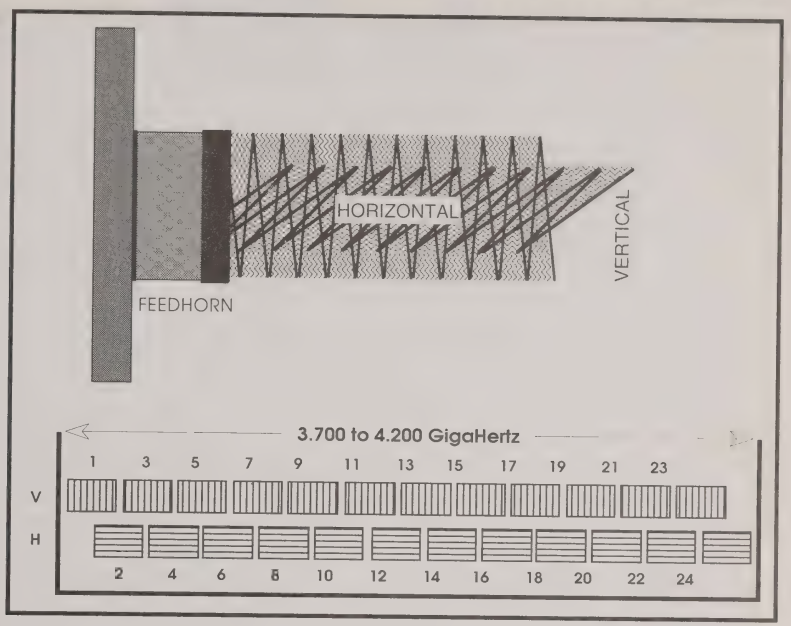
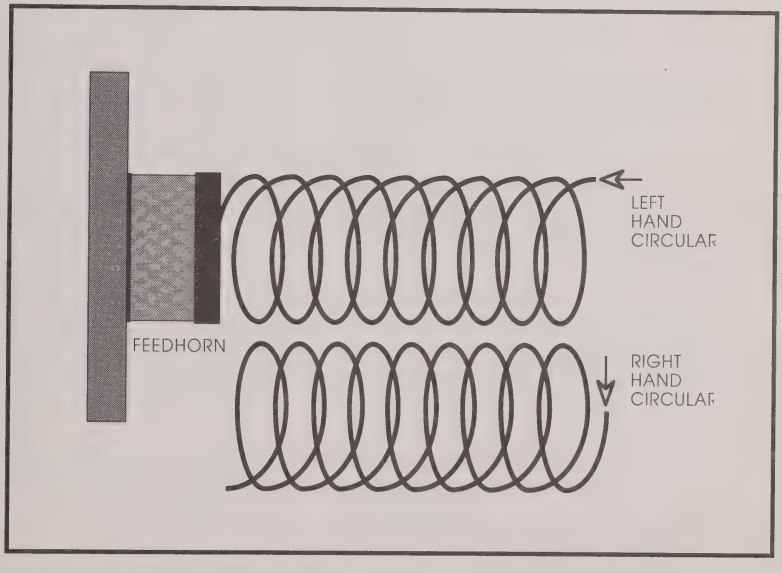


FIG.5-5. CIRCULAR POLARIZATION.



POLARIZERS

Almost all commercial satellites maximize their use of the limited frequency spectrums assigned for satellite communications by overlapping the transponders, with their polarization switching from one sense of polarization to the opposite sense every other transponder. This allows twice as many channels in the same amount of space. For example, when a feedhorn has been adjusted for best reception of a horizontally polarized transponder, the overlapping vertically polarized transponders cannot be seen. If the feedhorn inadvertently is set somewhere between vertical and horizontal polarization, more than one TV channel can be seen at the same time, an unsatisfying viewing experience at best.

In order to select the correct polarization, most feedhorns incorporate a small probe that is rotated until best reception is obtained. The probe is rotated by means of a small servomotor which is powered by either the indoor receiver or antenna positioner. By sensing the strength of the incoming signal, some receivers can select the correct polarization automatically. Many microprocessor-based receivers and IRDs can be programmed to recall the correct polarization format for each individual satellite stored in their memory.

A few manufacturers have figured out a way to eliminate all mechanical parts by electronically polarizing the LNB, instantaneously and silently. Rather than adjusting a servo-driven probe, these circuits electronically alter the polarization of the incoming microwave signal. This does introduce a small amount of signal loss, typically 0.1 to 0.2 dB, which for most applications is negligible. Electronic polarization provides instantaneous polarization adjustment with no moving parts that can give you maintenance problems in the future.

DUAL FEEDS

There are special feeds available which can be used to mount two C- or Ku- band LNBs at the focal point of the dish for simultaneous reception of both senses of polarization. These special "dual feeds" are used by multiple receiver systems so that each receiver in the system can independently select transponders of either polarization from a given satellite.

HYBRID FEEDS

Dual-band "hybrid" feeds place both the C- and Ku-band feed openings directly at the focal point of the antenna to provide the best overall reception from the maximum number of satellite TV channels. Although the placement of both the C- and Ku-band feed openings at such close proximity to each other results in a slight amount of signal loss at C-band, this loss will only affect the reception of the weaker C-band satellite channels. Hard-core videophiles can compensate for the nominal loss at C-band by switching to a lower noise temperature C-band LNB.

SATELLITE TV RECEIVERS

Satellite TV receivers and integrated receiver/decoders (IRDs) come with a wide range of features and options. You may be quite satisfied with a basic "no frills" receiver that provides a good picture into your home. After all, it doesn't matter whether you are driving a Hyundai or a Ferrari, you can still get around. On the other hand, the more expensive units generally add features that improve performance or provide increased versatility. When choosing from the variety of equipment in the marketplace, it is a good idea to review all of your options before you purchase, so you know the receiver which you select is the right one for you.

THE BASIC CONSIDERATIONS

When you go to purchase your system the salesperson should ask you a few questions about what features you would like. This will help to narrow down the available field of options and help determine the correct package for you. The price will vary a great deal between the low and high end systems. Knowing as much as possible about receivers and the available options will help you to be a smart consumer. Here are some of the typical questions which you may be asked:

Will the satellite receiver be connected to more than one TV in the home? If so, a UHF remote control is a handy option that will allow you to control the main satellite receiver from other rooms in the home.

Will you want one person be able to watch a satellite channel in the living room while another member of the family watches a different satellite channel in another room? In this instance, two receivers will be required.

Do you want to watch encrypted channels on both receivers? You will need a decoder for each receiver in order to do so.

Do you want to receive stereo audio from the non-encrypted channels? While the vast majority of the encrypted channels provide digital stereo, many of the non-encrypted channels as well as a host of auxiliary audio services (radio stations and specialty services) also are available in stereo, provided that your receiver has the appropriate stereo options.

Will you want to watch C-band as well as Ku-band satellite TV programming or be able to easily upgrade from a single to a dual band system at some point in the future? Make sure your dish and receiver are dual-band compatible.

Will you only want to watch programs from a single satellite ? To view programs from satellites occupying different orbital locations you will need to buy a receiver or IRD equipped with an antenna positioner.

We will explore the basic operational functions of satellite receivers and ex-

amine most of the available optional features in this chapter, starting out by describing integrated receivers.

INTEGRATED RECEIVERS

The first so-called "integrated" receivers were introduced in the United States back in 1984 when satellite manufacturers began to combine the satellite TV system's receiver, stereo processor, polarizer, and antenna positioner in one streamlined unit. These systems were the first step toward simple, automatic selection and tuning of satellite TV channels.

Today's integrated satellite receivers have evolved into full-blown computers. With special software programs built in, they function as the master control for the entire satellite TV system. Some integrated receivers carry so much memory that they are comparable to desktop personal computer systems. The receiver's wireless remote control has become a kind of keyboard and the TV set serves as a computer screen for displaying a variety of personal-computer-style menus that give the operator total control. The trend is toward flashy, highly-graphic video systems that can do it all.

Surprisingly, the very complexity of these computer-driven receivers makes them easier to use than ever before. They are pre-programmed at the factory to keep track of all the settings necessary for receiving your favorite satellite TV channels. All you have to do is select your favorite satellite TV channel from a menu displayed on the TV screen and the system does the rest. You don't even need to know which satellite is carrying the channel. Moreover, you can rely on the computer's electronic brain to remember and execute all the little adjustments required for perfect reception.

In their quest for simplicity of operation, however, manufacturers of integrated receivers have not forsaken technically-minded dish owners who enjoy having access to a plethora of electronic goodies. If you don't care to keep it simple, there are enough high-tech menus and advanced function commands to keep even the most avid "techie" happy.

REMOTE CONTROLS AND ON-SCREEN GRAPHICS

Most receivers are provided with remote controls. While some receivers still have front panel controls and an LED readout of the satellite name and channel number, most units now provide remote controls that can command the receiver to perform all available functions; in this case few or no control buttons will be found on the front panel of the receiver itself. Pushing various buttons on the remote control will bring up on-screen (on the screen of your TV) menus which provide you with a selection of possible choices.

In addition to guiding you through the installation instructions, most satellite receivers also use on-screen graphics to display relevant information on the working status of your system. Whenever you change channels, for example, the name of the satellite and the channel number will appear momentarily on the TV screen. On-screen graphics is a convenient feature to have when viewing satellite programming from a location where you can't see the readout provided on the front panel display of the receiver. The on-screen graphics and remote control work together to provide you with

FIG.6-1. PERHAPS THE FIRST FULLY DVB COMPLIANT MPEG2 RECEIVER DECODER AVAILABLE FOR THE DIRECT TO HOME (DTH) MARKET, THE PANASAT IRD520.

total hands-free operation of your satellite TV system.

Remote controls come in two varieties: infrared and UHF. The infrared remote controls transmit an invisible light beam back to the receiver, which has a sensing window on the front control panel. Infrared remotes, however, are limited to line of sight operations.

UHF remotes use a radio frequency to send the control signals back to an antenna mounted onto the receiver. Since UHF remotes use a radio signal instead of a light beam, the transmissions aren't limited to line of sight of the receiver. The combination of a UHF control and on-screen graphics allows for convenient operation of the receiver from different rooms in the house.

If there are two satellite receivers in the home, UHF cannot be used to control both units, because the remote control for one receiver would interfere with the other. Some receivers provide for both infrared and UHF remote control operation. Infrared is used in the room where the main receiver is located while UHF is used from all other rooms.

REMOTE FUNCTIONS

Hand held remote controls can range from the very simple to the very sophisticated. Most satellite receiver remotes allow you access to a wide variety of functions and special features. Since there can be many different ways of accomplishing the same task—and some receivers will offer more features than others—the remote controls for different brands and models of receivers will be designed slightly differently. Here is a list of common remote functions:

FIG.6-2. THE ONLY WAY TO BE REALLY SURE THAT YOU FULLY UNDERSTAND THE CAPABILITIES OF YOUR SATELLITE RECEIVER OR IRD IS TO READ THE INSTRUCTION MANUAL WHICH COMES WITH EACH UNIT.

Channel Up/Down. Designated keys on the remote will select which of the available transponders you want to see. Individual channels can be accessed either by directly entering their number on the remote's alpha numeric keypad or pushing the channel up/down button.

Antenna Positioning. Designated keys on the remote are used to access the receiver's programmed entries for the positions of the available satellites. In most cases, the receiver can be commanded to move to a new satellite by entering a two digit alpha numeric code (such as A1 or P2 for Asiasat 1 and Palapa B2P) for the desired satellite. Additional keys are used to fine tune reception by moving the dish slightly to the east or west.

Volume Up/Down. You can push the volume up/down button on the remote to control the audio level. Many remotes also come with a "mute" button that can be used to zap commercials and other annoying audio phenomena.

MENUS

The remotes for those receivers which offer on-screen graphics have a keystroke command that provides the viewer with access to a series of computer-style menus. Categories of menus include: installation set-up, satellite, channel, favorite channel, and audio tuning. Each menu contains a list of several related functions. The following functions commonly are included under one or more of the receiver's menus:

Satellite Format. Most receivers have been designed to effectively process both C- and Ku-band signals. The receiver, for example, can automatically choose a 24-channel format whenever a C-band satellite has been selected or a 32 channel frequency scheme whenever a corresponding Ku-band satellite has been selected. Moreover, the satellite format menu can be used to adjust and store in receiver memory the location, polarization, and skew settings for each individual satellite.

Channel Format. Some receivers and

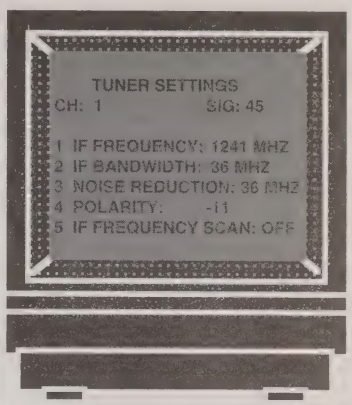
INTERNATIONAL SATELLITE RECEIVER MENU OPTIONS

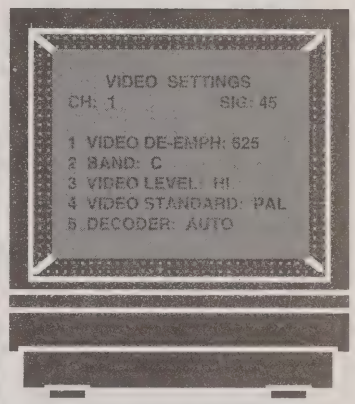
Some of the more advanced satellite receivers have been designed to allow the operator to view satellite TV channels originating from numerous countries within the Asia/Pacific region. Not all of these satellite TV channels use the same video and audio formats for their transmissions. The operator therefore must use the remote control to program the correct video and audio parameters into the receiver's memory on a channel-by-channel basis.

Tuner selections. The channel frequency for each satellite service can be fine tuned by adjusting the receiver's IF center frequency. Picture fidelity also can be optimized by adjusting the receiver's IF bandwidth and video noise reduction controls. Fine tuning of the polarization "skew" setting further optimizes the reception.

Video selections. To faithfully reproduce the luminance (brightness) and chrominance (color) signal components for each satellite TV channel, the receiver must be programmed to receive the correct video standard (525/625 line video and PAL, NTSC or SECAM color) used by each satellite TV channel. What's more, the video level should be set to either the LOW or HIGH setting.

Audio selections. Sound fidelity is enhanced by selecting the correct audio deemphasis for each channel (50, 75 and 125 µs or the European J17 standard). The correct audio bandwidth for each satellite TV service also must be programmed into memory: either 125, 230 or 400 kHz. The operator also will choose the correct audio format (monaural or stereo) and the correct audio subcarrier frequency or stereo frequency pair for each available TV service.





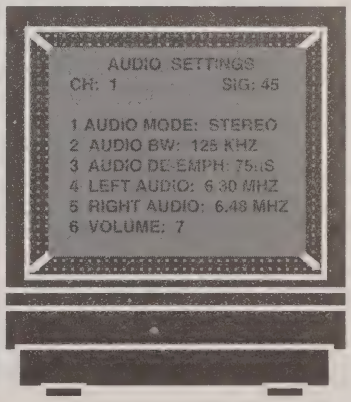


FIG.6-3. REMOTE CONTROL. (COURTESY CHAPARRAL COMMUNICATIONS.)

IRDs come from the factory with the channel format settings for the available satellites already programmed into memory. Satellite services, however, often move from channel to channel—or even satellite to satellite. What's more, new satellite services are being launched all the time. It therefore is important that dish owners have a way to change the various settings that are stored in the receiver at the factory.

The operator can custom program the receiver on a channel-by-channel basis to select special video and audio frequencies, enable or disable the descrambler module or engage video and audio band pass filters.

Favorite Video and Audio Channels. Some receivers also have the ability to retain up to 100 favorite stereo or monaural audio services as well as 100 favorite video services in memory. A directory of favorite video and audio services can be displayed at any time on the screen. Each favorite service is assigned a unique code which can be keyed via the remote control. By punching in the number for your favorite service of the moment, the dish will automatically careen toward the satellite which carries the service and the receiver will automatically select the correct channel frequency and audio subcarrier parameters.

Audio Format. Every unscrambled TV transponder carries the audio portion of the program on a subcarrier which is offset from the frequency of the main video carrier. Additional subcarriers on any transponder can also carry broadcast radio, news, or other "auxiliary services".

The audio menu is selected when tuning in to the desired subcarrier on any satellite TV channel. The main monaural subcarrier frequencies commonly used by the Asiasat and Palapa satellites are 6.2, 6.3, 6.48, 6.6, and 6.8 MHz. Auxiliary services may be found anywhere between 5.0 and 8.2 MHz.

The STAR TV services on Asiasat 1 also broadcast their programs in stereo using the Panda I® Sound System. The receiver that you select must be fully compatible with the Panda system in order for you to enjoy STAR TV broadcasts in stereo. Moreover, for full stereo sound to be produced by your receiver, the Panda I stereo mode and correct stereo subcarrier pairs—5.58/5.76 MHz (northern beam) or 6.30/6.48 MHz (southern beam)—must be selected and programmed into memory for each available STAR TV service. Some receivers may have had the stereo audio settings for existing services programmed into memory at the factory.

STAR TV's services on Asiasat 1 cannot be received in southern Australia or New Zealand because the satellite's coverage beam does not extend that far south of the Earth's equator. However STAR TV's new service on Palapa B2P can be received in Northwestern Australia and Papua New Guinea.

Most stereo receivers also provide for the selection of a wide or narrow audio filter. While the monaural audio for any satellite TV channel is always carried in the wide audio format, stereo TV broadcasts and auxiliary subcarrier services may be carried in a narrow audio format. The reception of these narrowband audio services will be enhanced by engaging the narrowband audio filter. Most receivers can store the narrowband setting in memory on a channel-by-channel basis.

OPTIONAL FEATURES

In addition to the standard features described above, many receivers come

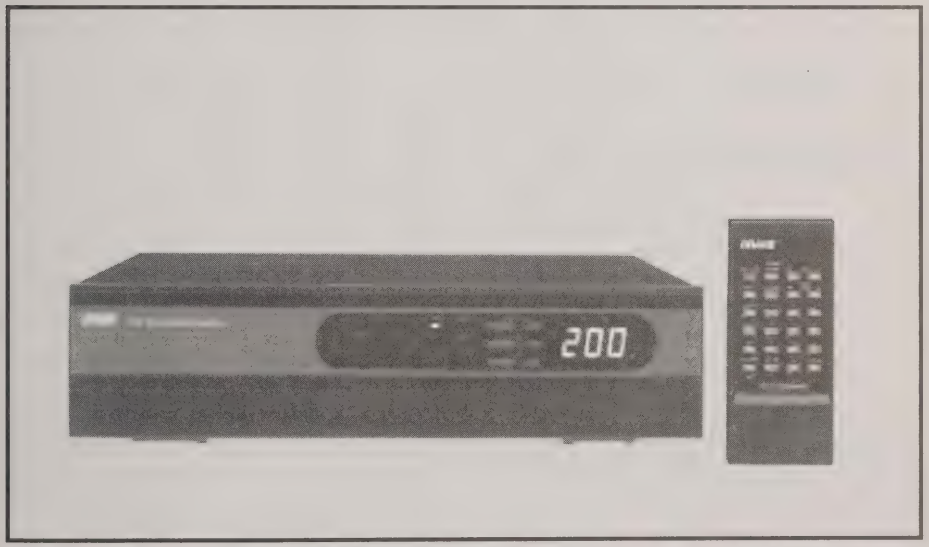


FIG.6-4. THE DRAKE ESR 700E INTERNATIONAL SATELLITE TV RECEIVER FEATURES MULTI-STANDARD VIDEO AND AUDIO OPTIONS, INCLINED ORBIT SATELLITE TRACKING, VIDEO NOISE REDUCTION, AND BANDWIDTH FILTERS WHICH ARE PROGRAMMABLE ON A CHANNEL-BY-CHANNEL BASIS. (COURTESY R. L. DRAKE CO.)

with a dazzling array of "bells and whistles"—exotic features that can enhance the performance of your satellite TV system. The following are some of the more commonly encountered optional features.

Auto Install. The installer merely has to find the first two satellites and the receiver will automatically locate the remaining satellites and program their locations into memory.

Auto Peak. After each satellite has been located, the receiver automatically selects the correct polarization format, skew setting, and video center frequency for every channel. The operator also can select auto peak at any time to readjust the antenna, polarization, skew, and channel settings for best performance.

Unfortunately, the auto peak feature is not perfect. When using auto peak, observe the reading of your receiver's *signal strength meter* to insure that maximum system performance has been obtained. This meter either will be found on the receiver's front panel or as part of the on-screen graphics menu. You can always use the receiver's manual controls to touch up any adjustments made after initiating an auto peak if necessary.

T.I. Filters. Many receivers also come with built-in filters which can be used to eliminate interference generated by terrestrial microwave links which share frequencies with the C-band satellites. These switchable terrestrial interference (TI) filters can be engaged manually by the operator whenever needed. Filter settings also can be stored in memory on a satellite-by-satellite and channel-by-channel basis.

Threshold Extension and Video Noise Reduction Filters. These filters can be used to improve receiver performance when viewing some of the weaker satellite TV channels. Threshold extension filters also can enhance the quality of reception from certain Ku-band satellite TV services that are transmitted within a much narrower frequency bandwidth (24 versus 36 MHz) than their C-band counterparts.

Receiver manufacturers try to maximize the incoming signal strength while keeping both external and internal noise to a minimum. This relationship is expressed as the Carrier to Noise Ratio (C/NR).

Every receiver has a threshold point (expressed in dBs C/NR). When the C/NR falls below this point, the video rapidly becomes noisy. Once the C/NR is a dB or more above threshold, impulse noise or "sparklies" disappear. The lower the receiver's threshold rating, the better. It is usually 7 to 8 dB C/NR.

Threshold Extension and Video Noise Reduction filters lower the receiver's C/NR through the use of specially shaped bandpass filters and other processing circuitry. Lowering the receiver's C/NR threshold has the same effect as if you used a lower noise temperature LNB or bought a larger antenna.

VCR Timer/Automatic Video Taping. Like VCRs, some receivers now come with circuitry that will permit the taping of multiple events over a period of two or more weeks. VCR-compatible receivers have their own internal "real time" clocks. The operator merely selects the satellite, channel, "on" time and "off" time for several events and the receiver's microprocessor will automatically move the

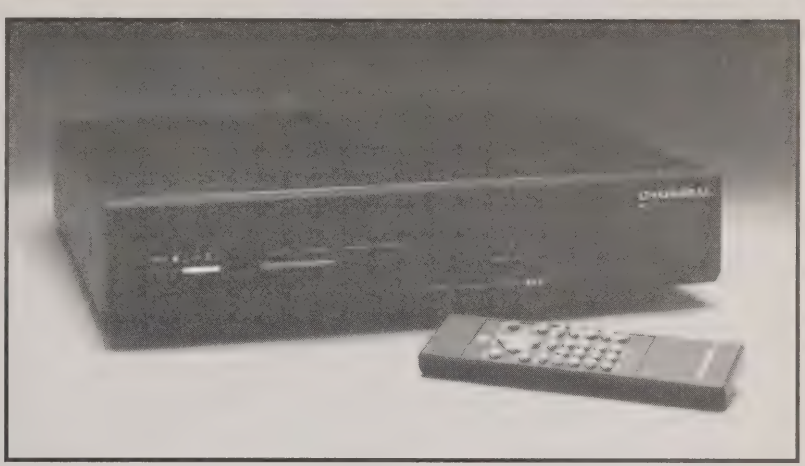


FIG.6-5. THE MC 115 STEREO SATELLITE TV RECEIVER. (COURTESY CHAPARRAL COMMUNICATIONS.)

dish, select the channel, and forward the video and audio signals on to your VCR for recording. However, you still must remember to pre-program your VCR to record the selected programs as they occur.

The VCR timer feature also can be used to fully automate your dish so that young children can view their favorite programs on schedule without needing adult assistance. By using the receiver's VCR timer circuitry, the entire satellite system may be completely programmed by the user at the beginning of each week to automatically adjust the system to specified channels at the designated times. When this occurs, all the kids will have to do is sit back and enjoy.

Before purchasing a satellite receiver, make sure that its taping capabilities match your specific needs. A satellite re-

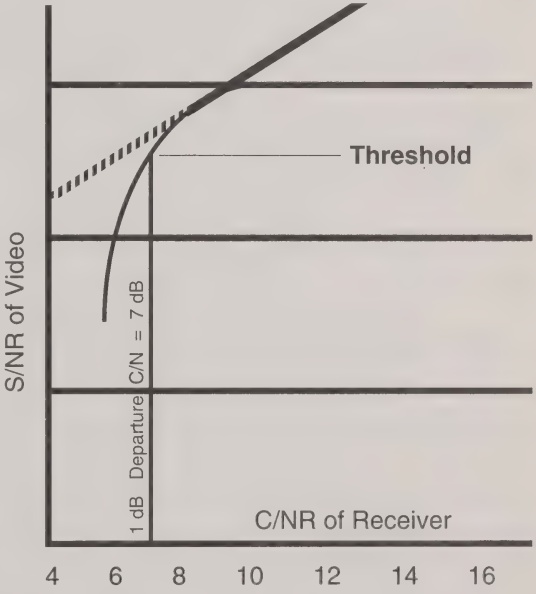
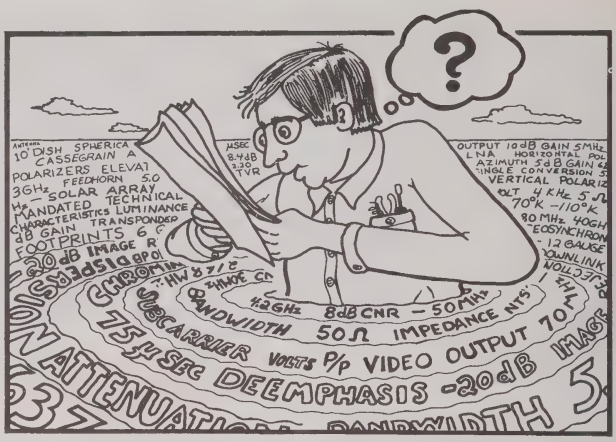


FIG.6-6. THRESHOLD IS THE POINT WHERE THE RELATIONSHIP BETWEEN THE SIGNAL TO NOISE RATIO (S/NR) OF THE VIDEO AND THE CARRIER TO NOISE RATIO (C/NR) OF THE INCOMING SATELLITE SIGNAL IS NO LONGER LINEAR.

ceiver, for example, may feature several levels of programmability. When placed in the "one-time" program mode, the receiver can be programmed to tape five individual events that occur at any time; when in the "weekly program" mode, each stored event will occur on time every seven days until deleted; and the "daily program" mode permits up to five events to be taped every day until deleted. Full memory protection is provided so that momentary power outages will not preempt the program which you have entered into the receiver's microprocessor.



Parental Lockout. You can program certain satellite TV channels so that they only can be accessed by keying in a special secret code. This feature can be used to prevent children from gaining access to services which you do not want them to watch.

Panda I® Sound System. To enjoy STAR TV's high quality stereo audio from Asiasat 1, make sure that you purchase a satellite receiver that is Wegener Panda I compatible.

Dolby Surround Sound. This is an audio enhancement that gives spatial depth to the audio broadcasts of major sports events and movies. The surround sound audio processor decodes the special surround sound signals and sends them to the home entertainment system's front and rear pairs of stereo speakers.

PCM Audio. The receiver must feature Pulse Code Modulation (PCM) audio tuning if you are to enjoy the digital audio transmissions transmitted by the TV services on the Japanese BS-3A and BS-3B DBS satellites.

RECEIVER SPECIFICATIONS

For those consumers not familiar with electronics, the technical specifications advertised within the sales literature can be baffling. Here is a list of some of the common satellite receiver specs and what you should look for when selecting equipment. Keep in mind that newer compressed digital video services such as those offered on Asiasat 2 will require a special receiver that is compatible with the DVB compliant MPEG2 standard and any conditional access system. Often the front panels of these receivers carry the logo of the service they are designed to receive.

TYPICAL SATELLITE RECEIVER SPECIFICATIONS

RF	
Input Frequency:	950 to 1750 MHz
Input Impedance:	75 ohms
2nd IF:	70 MHz
IF Bandwidth:	27 MHz
Threshold:	Less than 7 dB C/NR
VIDEO PERFORMANCE	
Standard:	NTSC, PAL-B/G, and SECAM, switchable [NTSC—Japan, South Korea & the Philippines [PAL—Asia, Australia, & New Zealand] [SECAM—Russia & Mongolia]
No. of Channels:	24 at C band; up to 32 at Ku band
Output Impedance:	75 ohms
Output Level:	1 volt peak to peak
AUDIO PERFORMANCE	
Audio IF Bandwidth:	130/230/400 kHz selectable
Subcarrier Frequency:	5.0 to 8.5 MHz
Audio Modes:	Mono & Panda I Stereo PCM (Japanese satellites only)
Preemphasis:	50, 75, 125 µs or J17 selectable
Peak to Peak Deviation:	100 kHz
Frequency Response:	+0/-3 dB 50 Hertz to 15 kHz
RF MODULATOR	
Output Frequency:	VHF (Ch. 3/4-USA) or UHF (Ch. 32E~40E)
Video Standard:	PAL-B/G or -I switchable; or NTSC-M depending on intended country of use.
POWER REQUIREMENTS	
Primary Power:	110/120 or 220/240 volts a.c., 50 or 60 Hz.
Power to LNB:	18 Volts d.c. @ 300 mA Nominal
Polarizer Output:	5 Volts d.c. @ 500 mA Nominal
ACTUATOR INTERFACE	
Motor Power:	36 Volts d.c. nominal, 3 A maximum
Sensor Type:	Pulse, compatible with reed, relay, optical disk or hall-effect switch; 5 Volts d.c. available for optical disk and hall-effect sensors.

THE RECEIVER IF FREQUENCY BAND

All LNBs convert the incoming satellite frequency band from the original frequencies to a lower intermediate frequency (IF) band, usually within the 950 to 1450 MHz spectrum. In the case of Ku-band LNBs, a "local" oscillator inside the LNB produces a signal that is lower in frequency than the incoming Ku-band signal. Called "low side injection" this local oscillator frequency beats or heterodynes with the incoming Ku-band spectrum to produce a 500-MHz block output signal that is the difference between the original satellite and local oscillator frequencies (see diagram below). The resulting channels appear within the block IF in the same order as they appear in the original satellite band. For example, a satellite channel assigned to the low end of the Ku-band (12.277 GHz within the 12.25 to 12.75 GHz Ku-band spectrum) will appear at 977 MHz in the 950 to 1450 MHz IF band.

C-band LNBs also use a local oscillator to produce the IF band for the receiver, but in this case an oscillator frequency that is higher in frequency than the incoming C-band satellite signal. This is called "high side injection." Here the order of the channels in the IF band is reversed (see Fig. 6-09 on the following page) and the polarity of the video also is inverted.

In order for the satellite receiver to be able to receive both C- and Ku-band signals, the receiver must be designed to compensate for the reversal of channel order and the inversion of the video when switching from Ku-band to C-band reception modes. Before purchasing a satellite receiver for dual-band reception purposes, make sure that the receiver is dual-band capable.

FIG. 6-7. LNB HIGH SIDE VERSUS LOW SIDE INJECTION MODES.

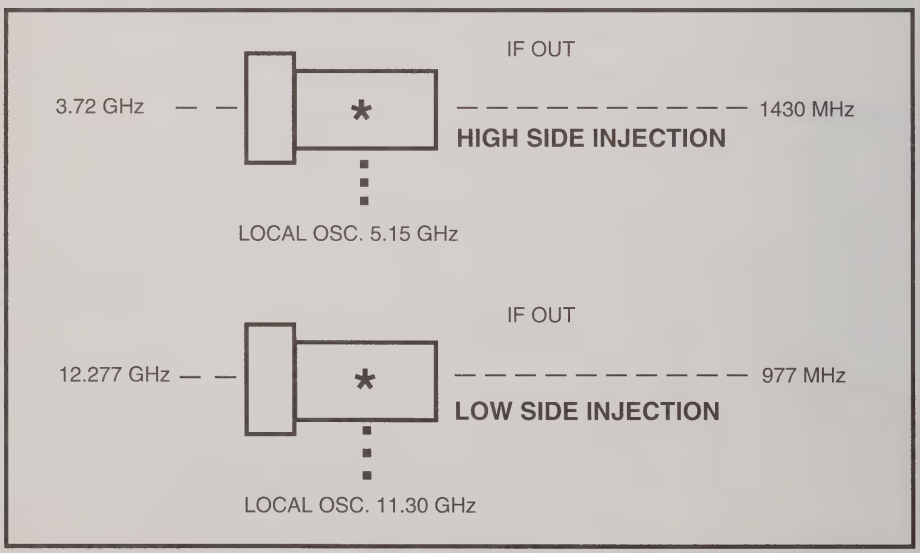


FIG. 6-8. LOW SIDE INJECTION MAINTAINS THE ORIGINAL ORDER OF THE SATELLITE CHANNELS.

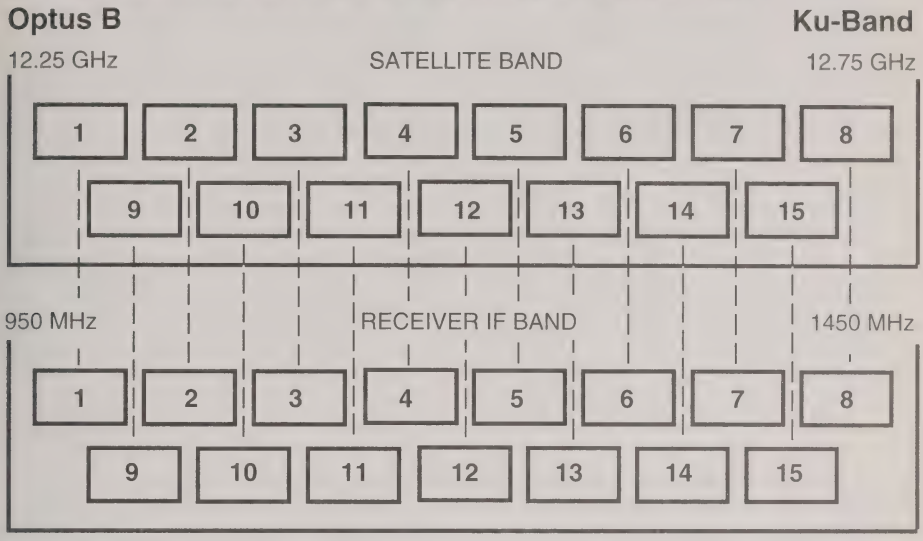
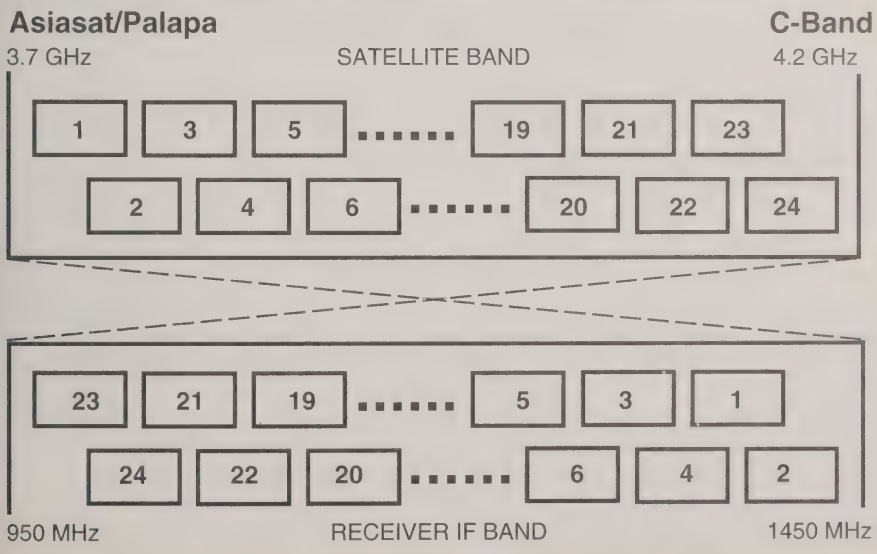


FIG. 6-9. HIGH SIDE INJECTION REVERSES THE ORDER OF THE SATELLITE CHANNELS AND INVERTS THE VIDEO.

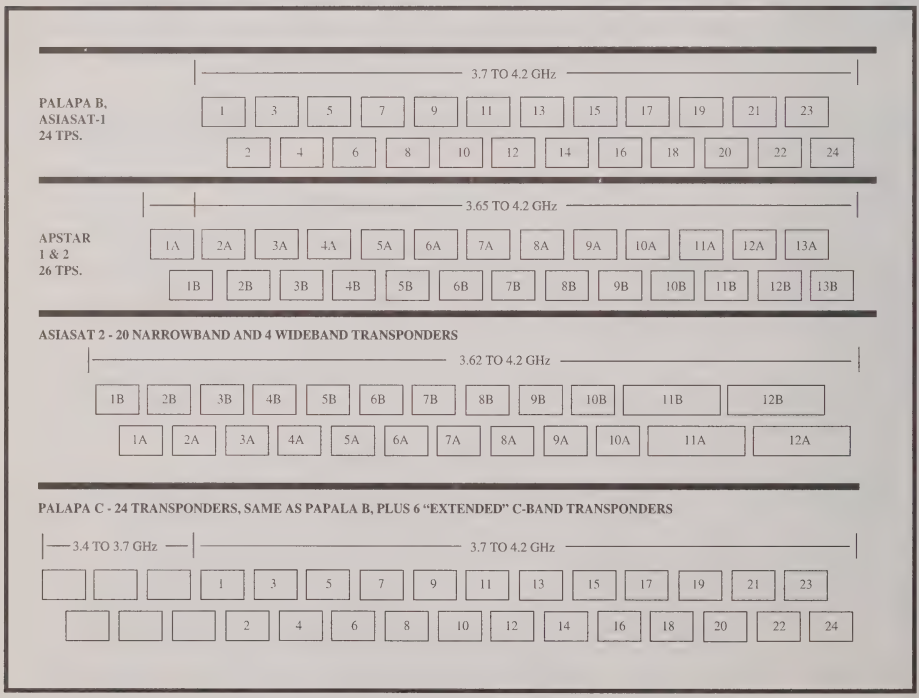


RECEPTION OF THE EXPANDED C-BAND CHANNELS

Although most C-band satellites serving the Asia/Pacific Region operate within the standard 3.7 to 4.2 GHz frequency range, there are a few exceptions. At the time of writing, Russian-built satellites were transmitting TV programs using frequencies below 3.7 GHz, including TV Moscow and the Asian Television Network (ATN). To view these program services, the receiver must have an expanded IF frequency range which extends from 950 MHz to 1750 MHz.

Within the next year, this capability will be even more important. New generation Palapa, Asiasat, Apstar, and Rimsat satellites (see Fig. 6-10 below) carry additional C-band transponders operating within the 3.4 to 3.7 GHz "expanded C-band" frequency range. Only those receivers capable of tuning through the entire 950 to 1750 MHz IF frequency range will be able to receive these new channels. Fortunately the majority of receivers manufactured today for PAL markets cover an expanded IF frequency range of 950-2050MHz. as this is necessary in Europe where some are making equipment capable of tuning beyond 950-2100MHz.

FIG. 6-10. SATELLITES OPERATING WITHIN THE EXPANDED C-BAND FREQUENCY RANGE.



SATELLITE INSTALLATIONS

Although the vast majority of satellite TV purchasers leave the installation of their home satellite TV systems to experienced technicians, an increasing number of individuals are electing to install their own systems. A third popular option is to undertake the bulk of the installation yourself, including mechanical parts such as assembling the dish and running the cables, and then have a technician tackle the more complicated installation steps, such as adjusting the dish so that it will properly track the satellite arc or programming the satellite receiver. The satellite technican can complete both of these steps quickly and easily once the equipment is in place. If you have not previously operated a satellite TV system and aren't sure what to expect, the technician also can walk you through the basic operating procedures, explain all receiver functions, and give you confidence that you will be getting the most you can out of your new system.

Your satellite retailer should have a technician available or be able to recommend one to you. He also should supply you with the information that you will need in order to track the satellites that are available from your location: azimuth, elevation, and declination angles. If not, you can derive this information from the charts provided within this chapter or obtain the data by taking readings off another working antenna in your area.

Your antenna and electronic components will come with assembly and operating instructions. The following step by step guide will walk you through the installation and explain the various procedures that you will perform along the way. Whether you decide to tackle the installation on your own or to hire a technician, an understanding of site selection criteria, cable connections between components, and dish aiming techniques will improve your operating skills and increase your enjoyment of the system.

SITE SURVEYS

Satellite signals are microwaves that travel in a straight path along the line of sight. Since all geostationary satellites are positioned over the Earth's equator, if you want to receive them from the southern hemisphere, your antenna must have an unobstructed view of the northern (or southern for sites located above the equator) sky. So, before you go running out and spending hundreds or even thousands of dollars for an earth station, you should be sure there are no tall buildings, trees, power poles, or other substantial obstacles to prevent the signals from reaching your dish.

Your local satellite retailer usually can conduct a site survey at your location;

often the fee for his service is deducted from the eventual purchase price of a system. If the site survey takes place in the late Fall or Winter, you may need to take into account the foliage of nearby trees and bushes that will be in place during the Spring and Summer months. Future construction plans of neighbors or nearby businesses also must be considered; any new buildings could be in a position to affect your reception.

You can conduct your own preliminary survey by standing in your backyard and looking toward the north (or south for sites located above the equator). If you have a clear and unobstructed view of the sky from the northeast to the northwest (or southeast to southwest for stations north of the equator) then you are in luck. However, the view from many installations—especially those in urban or suburban areas—will be blocked in some direction. At these restricted sites, some satellites may not be in view. To determine which satellites will be visible from your earth station, you will need to learn some basic techniques for locating the birds.

AZIMUTH AND ELEVATION

Azimuth and elevation are the two basic coordinates used to determine each satellite's position in the sky. The azimuth coordinate represents the bearing of the satellite from your location, while the elevation is the angle at which the dish looks up at the bird. Every satellite within view of a specific installation has its own unique pair of azimuth and elevation coordinates. Given the site's latitude and longitude, the az/el coordinates for any satellite are fairly simple to calculate. The charts which appears on the following pages provide the exact azimuth and elevation coordinates for Asiasat 2 and the Optus satellites.

Once you know the azimuth coordinates for a specific satellite, you can use a compass to point the antenna in the right direction. To achieve the required accuracy, you must correct the compass readings for true north; you can call up the control tower at the nearest airport to find out the correction factor for your location. If true north is east of magnetic north, the correction factor must be subtracted from the compass readings; when true north is west of magnetic

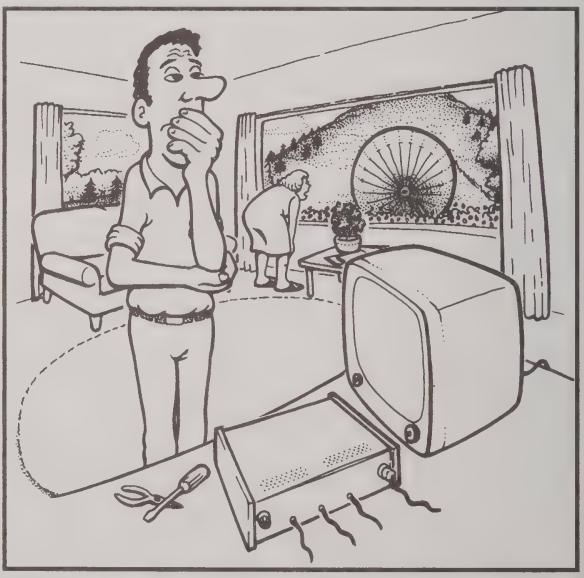


FIG. 7-1. "LOVE, I MAY HAVE FOUND THE REASON YOU CAN'T PICK UP ANYTHING WITH THE DISH."

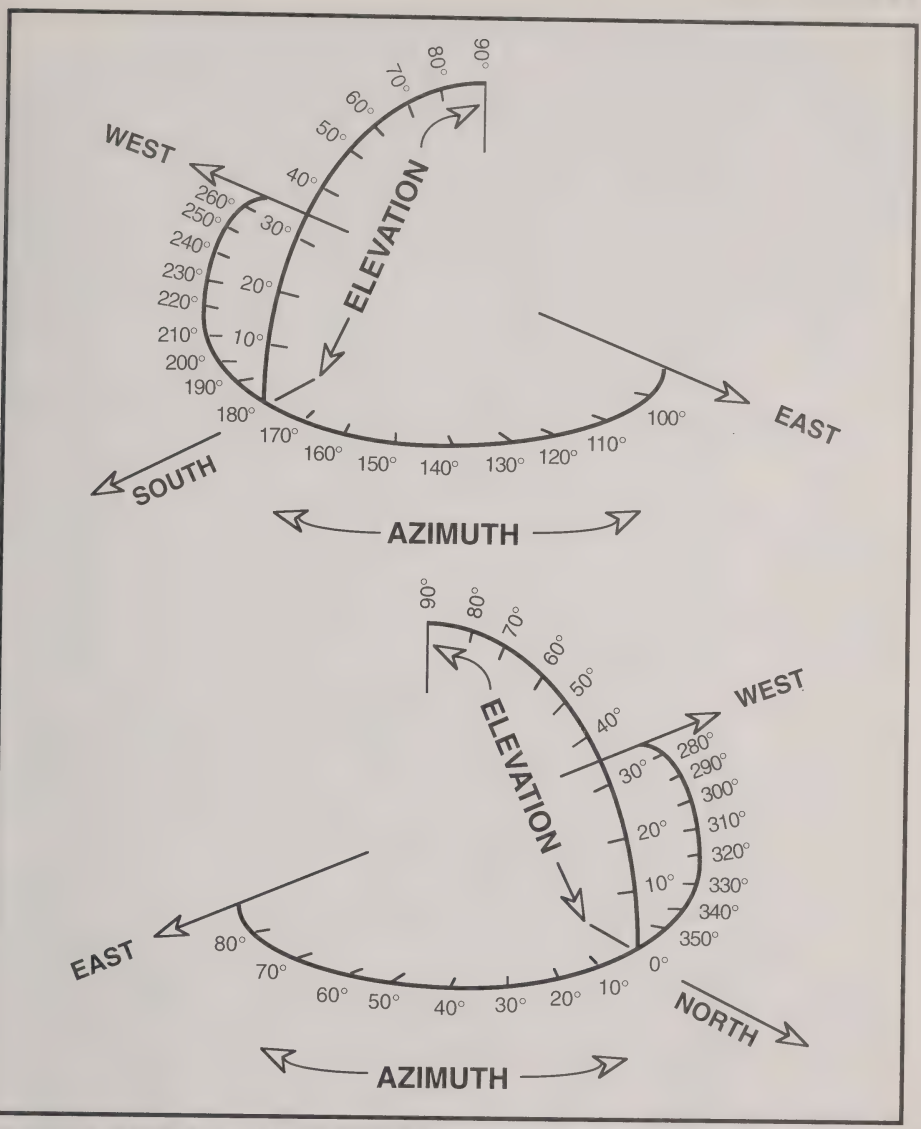


FIG. 7-2 & 7-3. THE AZIMUTH VALUES MUST BE ADJUSTED TO CORRESPOND WITH LOCAL TRUE NORTH / SOUTH BY ADDING (OR SUBTRACTING) A MAGNETIC CORRECTION FACTOR WHICH CAN BE OBTAINED BY CALLING THE LOCAL AIRPORT CONTROL TOWER. THE ELEVATION ANGLE FOR ANY SATELLITE IS ALSO REFERRED TO AS THE INCLINATION ANGLE, WHERE THE HORIZON IS REFERENCED AS A ZERO DEGREE ANGLE AND THE PERPENDICULAR ANGLE, OR STRAIGHT UP, IS NINETY DEGREES.

ASIASAT 1 EIRP AND AZ/EL COORDINATES

Country	EIRP Range	Major City	EIRP	TVRO	Elevation/Azimuth	
China	32~36 dBW	Shanghai	36 dBW	1.8m	50	209
Japan	30~34 dBW	Tokyo	30 dBW	3.7m	35	229
South Korea	35~35 dBW	Seoul	36 dBW	2.4m	42	213
North Korea	35~35 dBW	Pyongyang	36 dBW	2.4m	40	213
Mongolia	30~34 dBW	Ulan Bator	32 dBW	3m	35	182
Georgia (CIS)		Tbilisi	32 dBW	3m	13	110
Russia (CIS)		Vladivostok	34 dBW	2.4m	33.7	216
Ukraine (CIS)		Sevastopol	30 dBW	4.5m	4.1	103
Taiwan	33~35 dBW	Taipei	35 dBW	2.4m	55	215
Hong Kong	35 dBW	Hong Kong	35 dBW	2.4m	62	202
Philippines	Up to 31 dBW	Manila	28 dBW	5m	65	227
Vietnam	34~36 dBW	Hanoi	35 dBW	3m	65	180
Kampuchea	36~37 dBW	Phnom Penh	37 dBW	1.8m	76	177
Laos	36~37 dBW	Vientiane	37 dBW	1.8m	69	171
Thailand	35~37 dBW	Bangkok	37 dBW	1.8m	73	160
Malaysia	Up to 35 dBW	Kuala Lumpur	35 dBW	2.4m	84	127
Singapore	32 dBW	Singapore	32 dBW	3m	88	130
Indonesia	Up to 33 dBW	Medan	31 dBW	3.5m	81	115
Myanmar	33~37 dBW	Rangoon	32 dBW	3m	68	150
Bangladesh	33~35 dBW	Dhaka	33 dBW	3m	58	146
India	23~37dBW	New Delhi	37 dBW	1.8m	45	132
Bhutan	33~34 dBW	Thimbu	33 dBW	3m	53	149
Nepal	33~35 dBW	Kathmandu	34 dBW	3m	52	146
Pakistan	35~37 dBW	Karachi	37 dBW	1.8m	40	119
Afghanistan	35~37 dBW	Kabul	37 dBW	1.8m	34	128

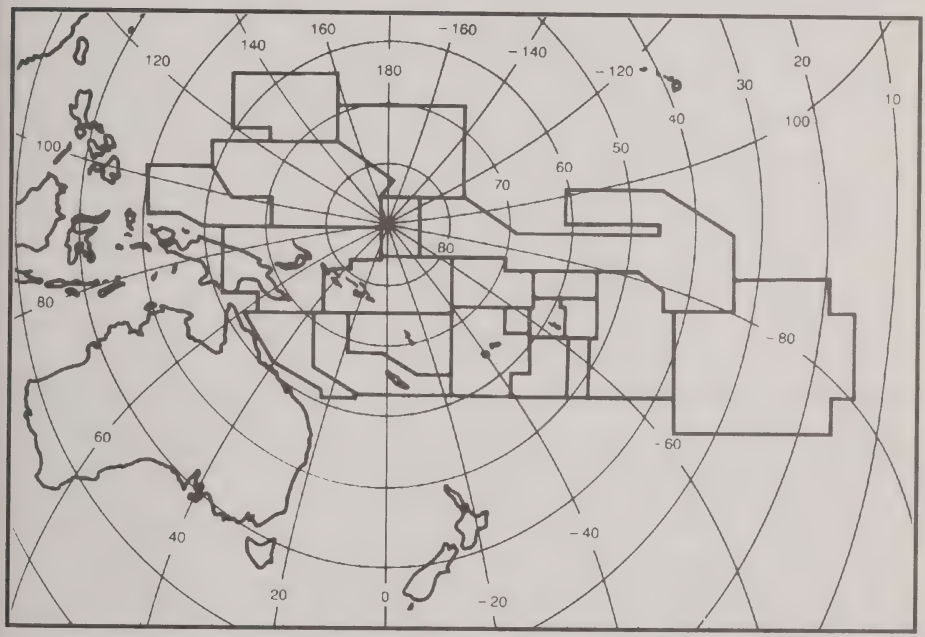
ASIASAT 2 AZ/EL COORDINATES

Territory	Cities	Elevation Degrees	Azimuth	Territory	Cities	Elevation Degrees	Azimuth
Australia	Adelaide	32.9	306.1		Madras	61.9	121.4
	Brisbane	24.9	289.5	Indonesia	Jakarta	79.6	315.3
	Darwin	52.1	290.3	Japan	Tokyo	31.6	234.4
	Hobart	22.1	302.5	Korea	Seoul	38.9	219.6
	Melbourne	26.6	301.9	Malaysia	Kuala Lumpur	86.2	196.5
	Perth	49.3	332.5	New Zealand	Auckland	3.9	279.6
	Sydney	23.9	294.3		Christchurch	4.2	282.5
Bangladesh	Dhaka	60.1	156.3	Nepal	Kathmandu	51.6	147.5
Brunei	Bandar Seri B.	72.7	252.4	Pakistan	Islamabad	42.0	135.9
Cambodia	Phnom Penh	75.5	201.0	Philippines	Manila	60.5	235.3
China	Beijing	41.0	203.3	Saudi Arabia	Riyadh	24.4	106.6
	Guangzhou	59.4	209.8	Singapore	Singapore	85.4	255.3
	Chengdu	54.5	187.1	Taiwan	Taipei	52.2	223.0
Hong Kong	Hong Kong	59.5	212.6	Thailand	Bangkok	73.5	180.0
India	New Delhi	48.4	138.2	Viet Nam	Hanoi	64.7	193.7
	Bombay	55.9	126.9		HCM City	75.9	209.7

FIG.7-4. ASIASAT 1 (TOP) AND ASIASAT 2 (BOTTOM) AZIMUTH/ELEVATION COORDINATES (IN DEGREES).

156 degrees east longitude

160 degrees east longitude



164 degrees east longitude

FIG. 7-5. OPTUS AZIMUTH / ELEVATION COORDINATES FOR SATELLITES AT 156, 160, & 164 DEGREES EAST LONGITUDE.

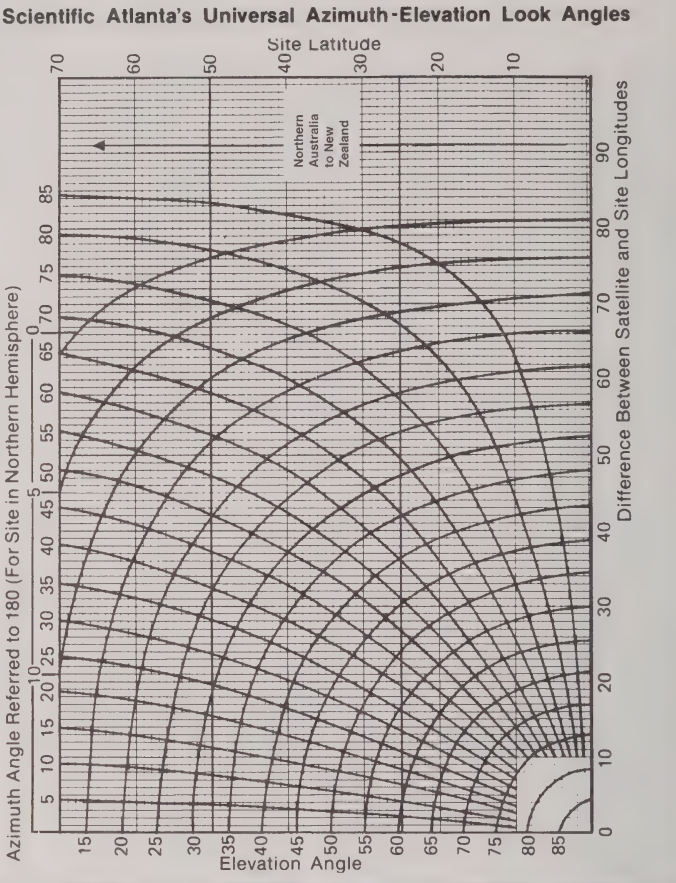
FIG.7-6. SCIENTIFIC ATLANTA'S UNIVERSAL AZIMUTH-ELEVATION LOOK ANGLE CHART.

1. Subtract site longitude from desired satellite longitude and plot this value on the bottom scale of the chart.

2. Plot the site latitude using the scale on the right side of the chart.

3. At the point where 1. and 2. intersect, determine the elevation angle and difference in azimuth using their respective graphs.

4. If the value obtained in step 1 is a positive number, add the difference in azimuth from step 3 to 180 to obtain the azimuth heading from true north. If the value is a negative number, subtract the difference in step 3 from 180.



north, the correction factor is added. All compass readings should be taken out in the open, well away from large metal objects or overhead a.c. power lines and transformers.

From any location, the satellite nearest to true north will be at the highest point of elevation of all the birds. The further away the satellite's bearing is from due north, the lower its elevation will be. At some point, the elevation of satellites to the extreme west or east of your location will fall below the horizon, preventing reception. That is why satellite TV stations in Australia cannot view European communications satellites, and vice versa.

An inclinometer is used to measure the degrees of elevation, or "tilt", of the dish. Inclinometers, which sometimes are referred to as "angle finders", are readily available from sources within the satel-

lite TV industry. Hardware shops and department stores may also sell inclinometers to carpenters who use them to measure roof pitch angles.

An inclinometer also can be used during the site survey to determine whether obstructions would block out any of the available satellites. Position the inclinometer on a level surface at the center of the site, and line it up with the bearing, or "azimuth", of the satellite under consideration. Then you can tilt the inclinometer back until it indicates the desired satellite's elevation. By sighting along the edge of the inclinometer, you should be able to tell if any obstacles would be between the site and the satellite.

If you determine that there will be obstructions that will interfere with your reception of a single satellite or even several satellites, then you may elect to remove these obstacles. In some cases the elimination of a troublesome tree branch may suffice. Where the obstruction is part of a nearby building or hill, the proposed dish site sometimes may be moved from ground level to a more advantageous rooftop location. A tall pole extending from the ground up the side, and anchored to, the house may allow the antenna to peer over the roof and receive a clear view of the satellites while not actually being anchored to the rooftop. For extreme cases of obstruction, however, the avid video enthusiast may have to consult a real estate agent.

In some Asian countries, microwave interference from land-based telephone transmitting stations, or airport, shipyard, and military radar installations, also can restrict or even preclude C band satellite reception. If your home is between two microwave links or near a radar installation, your reception may be affected. In Australia and New Zealand, terrestrial microwave interference is the rare exception rather than the rule.

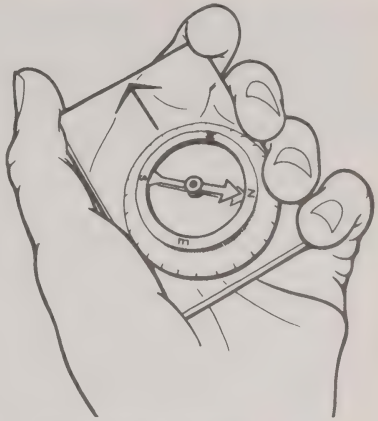


FIG.7-7. AN INEXPENSIVE COMPASS.

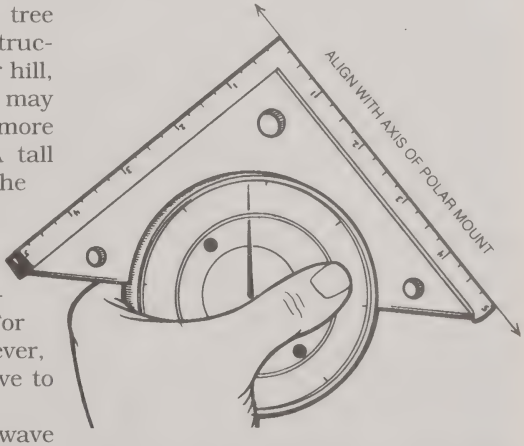


FIG.7-8. DO NOT BE CONFUSED BY TWO-EDGED INCLINOMETERS. YOU WILL GET ONE READING WHEN YOU HOLD IT AGAINST ONE EDGE, AND ANOTHER READING WHEN HELD AGAINST THE OTHER EDGE. USE THE EDGE UNDERNEATH THE "0" DEGREE MARK ON THE INCLINOMETER'S SCALE.

In those countries where microwave interference is a major potential problem, the best way to check for interference is to have your local satellite TV retailer perform an on-site demonstration with a portable dish. To detect all potential interference, the test should be performed right at the spot where the proposed dish will stand. A difference of only a few feet can be critical.

Any on-site demonstration should be made on a weekday, when telephone and other microwave traffic is at its peak. If you are in a business area, test during business hours; in a residential area, check it later in the day. In the event that some interference is present at your location, there are filters available that can often eliminate it. Information is provided on microwave filters in the chapter on troubleshooting.

In some communities, there may be zoning or town planning ordinances that limit satellite TV installations. Make sure that your system will comply with them.

SMALL DISH INSTALLATIONS

With the proper tools and a modicum of enthusiasm and effort, it should not be difficult for the do-it-yourselfer to

The ESSENTIAL SATELLITE INSTALLATION KIT
(What You'll Need Before You Start)

Tools

Compass & inclinometer
Post hole digger & pointed shovel
Screwdriver, tape measure, crimp tool
Wire strippers, wire cutters, razor knife
Electrical power cord with multiple a.c. outlet
Large and small adjustable wrenches and at least one 7/8 inch wrench
Drill with large bit (masonry for concrete block or wood bit for frame homes)

Supplies

Plastic wire ties
Voltage surge protector
Quick setting concrete mix
Connector sealer (Coax-seal, etc)
Current Satellite TV Program Guide
Ground rod, clamp, and copper ground wire
"F" connectors (RG-56 type for direct burial cable)
Direct burial cable with two coaxial cables, one servo, and one actuator motor cable
Steel pole of the correct length and outside diameter for your dish's mount
Plastic plate to cover the hole in the wall where the cable enters the house

install a small, fixed satellite antenna for receiving TV programs from an individual satellite. In many cases, the most important step will be to select and install the appropriate antenna mount for your particular location and living situation.

SELECTING THE MOUNT

Mounts are manufactured to accommodate a variety of possible placements such as on the ground, attached to an outside wall, or under the eave of the house. Roof mounts are available that either penetrate the surface of the roof and attach to the building's rafters or mount directly on the top of a flat roof. Above all, select the type of mount which can be installed where the antenna will have a clear and unobstructed view of the satellite of choice throughout the year.

ATTACHING THE ANTENNA TO THE MOUNT

Once you have securely fastened the antenna's mount to the building or a supporting pole, mount the antenna as indicated in the assembly directions. Do not fully tighten down those bolts which anchor the antenna at a specific position of elevation and azimuth until you have adjusted the antenna pointing to maxi-

FIG. 7-09. A SMALL APERTURE ANTENNA INSTALLATION. (COURTESY DIRECTV)

mize signal reception. Mount the feedhorn and LNB onto the feed support supplied with the antenna.

RUNNING THE CABLES

A coaxial cable for the LNB will have to be installed between the receiver's location in the home and the feedhorn and LNB out at the antenna. Systems dedicated to the reception of a single satellite which uses two senses of polarization to transmit TV signals, such as Optus B, also will require a two-or three-wire cable to connect the feedhorn's polarization connections to the receiver. Cable clips can be used to fasten these cables to the side of the building. Run the cable a bit below and then back up to the hole into the building, thus providing a "drip loop" to prevent rain from running down the cable and into the building. Quality crimp type "F" connectors should be used at each end of the coaxial cable, although the reusable twist-on F connectors are gaining in popularity.

The power for the LNB also is supplied by this coaxial line. Whenever you plug the receiver into the home's a.c. wall receptacle, electricity is being sent up this line. To avoid a short circuit that would blow the receiver's fuse or circuit breaker, or even damage the LNB, always unplug the receiver whenever connecting or disconnecting the system's coaxial cable.

PEAKING ANTENNA PERFORMANCE

Before connecting the cable to the LNB, determine which method you will use to accurately aim the antenna at the satellite of choice. One method used to peak the reception of standard analog TV signals is to view the available TV services from this satellite while adjusting the antenna's alignment. You can then fine tune antenna pointing until all stray impulse noise or "sparklies" have been eliminated for all available channels. You can get close to maximum system performance using this method.

FIG. 7-10. A SATELLITE SIGNAL LEVEL METER. (COURTESY PROMAX.)

The above-mentioned method is not at all appropriate when receiving digitally compressed satellite TV services. Receiving digital signals is an all or nothing proposition: you will either receive a perfect picture, or no picture at all. There is no intermediate state of poor or marginal reception which you can use as a starting point. In this case it is essential that you use some kind of signal tuning meter to detect the presence of signal and then peak the antenna for maximum performance.

The use of a tuning meter also is a good idea when receiving standard analog TV signals. Rain, fog, snow or even rain-filled clouds passing overhead can reduce the intensity of any Ku-band satellite signal reaching your antenna. If you tune your antenna by watching the TV

screen you may receive a wonderful picture at the time of installation—when there may be enough signal to exceed the receiver's threshold rating—but subsequently lose the signal whenever bad weather occurs.

Keep in mind that the meters installed on most satellite receivers are not nearly as sensitive as external peaking meters. That is why it is so important to peak system performance at the outset, so that the amount of signal reaching the receiver exceeds the unit's threshold level. This signal margin will then be there to compensate for any degradation of signal which occurs during adverse weather conditions.

The front of the receiver may have a signal level meter, an LED signal display, or provide an on-screen graphic which displays relative signal strength on your TV screen. Any of these signal strength indicators can be used to peak your signal reception if the receiver (or TV set in the case of on-screen graphic signal indicators) can be brought outside for this purpose—especially when peaking an antenna that is mounted on the ground or a flat roof. If you decide to move the receiver and TV outside, an extra length of coaxial cable and LNB/feedhorn cable will be needed to temporarily connect the receiver to the LNB.

It is impractical, however, to lug the receiver and/or TV up a ladder to peak an antenna mounted on the side of a building or under the eave. In this case it would be best to acquire an in-line, signal-strength meter for performing this task. What's more, a dedicated signal-strength meter also will be more accurate and sensitive than any other meter supplied inside your satellite receiver. Best of all, some portable meters provide an audio tone which increases in pitch as the signal becomes stronger. As you adjust the antenna slightly to the right/left and up/down, the audio tone will assist you in finding the ideal antenna pointing. (See Chapter 11 for further information concerning satellite instruments.)

One word of caution concerning the use of a signal strength meter: you must always be sure that you are receiving the correct satellite before you begin using the meter. There are many satellites serving the Asia/Pacific Region these days, and you don't want to do a lot of work only to find that you are anchored onto the wrong bird! Scan through the available channels at the beginning, and again at the end, of the installation process to ensure that you are indeed getting the desired satellite TV services.

The signal strength meter may even supply the d.c. voltage needed to power up the LNB and therefore can connect directly to the LNB. Signal meters which do not supply power to the LNB will have to be inserted in the coaxial line running from the receiver to the LNB using a special "tap" connector and a coaxial jumper cable. This tap supplies three connectors: one connects to the LNB, the second connects to the receiver, and the third supplies the connection that allows the meter to "tap" into the line and make the required signal strength measurements. Once you have completed the antenna alignment, you can tighten down all of the mounting bolts to prevent strong winds or rain from repointing the antenna for you.

SETTING THE POLARIZATION

The feedhorn support which comes with the antenna holds the feedhorn and

LNB at a fixed position towards the front of the antenna. If this support has an adjustment for setting the distance between the feedhorn opening and the surface of the dish, try moving the feed in and out in tiny intervals of a fraction of a centimeter to see if the signal strength increases.

Most of the available satellites, including the Optus B birds, use opposite senses of linear (horizontal/vertical) polarization to transmit a greater number of channels from a single orbital position. In this case, check to see that you can "skew" the feedhorn's polarizer by using the receiver's polarization or skew control. You should be able to skew slightly past peak performance when receiving channels using either sense of polarization.

LARGE DISH INSTALLATIONS

POURING THE PAD

If you elect to proceed with the installation of a large aperture antenna yourself, you will need to construct a foundation for the mount. In the case of a pole-mount antenna, a steel pipe is placed in a hole in the ground and embedded in concrete. Because it will take a few hours for the concrete to harden, it is a good idea to set the pole the day before you construct the antenna. You also can buy quick drying concrete products which will set up in less than an hour. Be sure to use a level to ensure that the pipe is "plumb" before the concrete sets.

Other types of dish mounts will require a concrete pad for the foundation. Concrete piers extending well below any frost line should be incorporated into the pad design. Certain types of antenna mounts merely need a level surface. Detailed instructions are supplied by the dish manufacturer.

For rooftop installations, the roof structure must be able to support the weight of the dish, as well as withstand the uplift forces of several thousand kilograms resulting from moderate and high-speed winds. After all, nobody wants the roof torn off and the dish flung through the sky.

Because roof top installations are more susceptible to microwave interference

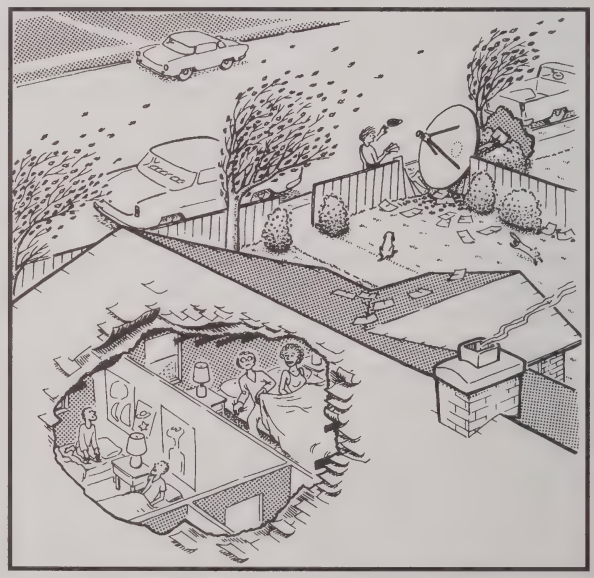


FIG.7-11. ROOF MOUNTS MUST WITHSTAND HIGH WIND LOADS.

than those on the ground, a site survey with a spectrum analyzer or an on-site rooftop demonstration with a small portable dish is an absolute necessity in any country where microwave interference is a major potential problem. If several of your neighbors have antennas, you can check with them to see if they are experiencing any interference problems.

ASSEMBLING THE DISH

The dish antenna should come with a detailed set of instructions covering all the essential construction information. When you first receive the dish, check to see that all parts listed in the manual are present and accounted for. Read over the instructions to see what tools and other materials will be required. If assistance during assembly is recommended, arrange to have a friend or two available to help lift the dish onto the pole.

On the evening prior to assembly, check the local weather forecast to ensure that your efforts will not be interrupted by rain or heavy winds. Begin assembly early in the day to allow enough time to complete the project.

Take care during the assembly to ensure that you get the most accurate curve possible. Many popular dishes today are comprised of four sectional preassembled panels called "quads" which bolt easily together. You'll want to have the dish fully assembled and anchored before leaving it unattended.

MOUNT ALIGNMENT

The pivotal axis of a polar mount antenna must be accurately aligned to true north. Even when this alignment is done with an engineer's transit, slight inaccuracies in the measurement may result, causing uneven tracking of the geostationary satellites. Corrected compass readings may be even further off the mark. While compass readings may be useful during the site survey for locating a clear view of the satellites, the real test of your polar mount's alignment is the video reception which you obtain.

When mounting the antenna onto the pole, tighten the bolts just enough to

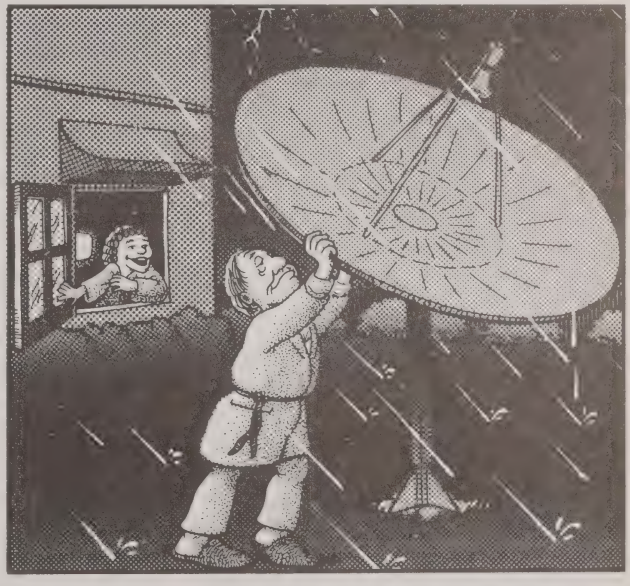


FIG.7-12. "BASIL! I TOLD YOU TO START PUTTING THAT TOGETHER EARLIER IN THE DAY. HURRY UP OR WE'RE GOING TO MISS THE START OF MOONLIGHTING."

hold the antenna in place. Tightening the bolts down firmly on the pole should be one of the very last things you do, and should be done only after you have gotten the dish to track the satellites properly. Tightening beforehand can dimple the pipe, making it more difficult to make subtle adjustments in alignment.

MOUNTING THE LNB AND FEEDHORN

Extreme care should be taken when bolting the LNB to the feedhorn. Do not touch the probe inside the mouth of the LNB. This probe can be adversely affected by grease or dirt. Also make sure that the neoprene gasket that goes between the feedhorn's flange and the mouth of the LNB is "seated" properly in the groove provided. Otherwise, moisture can seep into this opening and disrupt your reception.

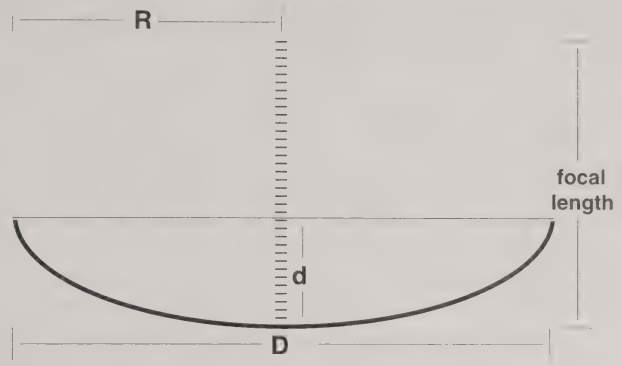
The center of the feedhorn must be supported exactly at the focal point of the dish. The focal distance between the center of the dish and the mouth of the feedhorn will vary between different models of antennas, depending on whether the manufacturer has used a deep or shallow dish design. The exact distance will be provided in the instructions.

There are two feed support styles available, one of which will be supplied with your antenna. A "button hook" support, sometimes called an LNB tube, is a single piece of tubing which extends from the center of the dish outward. The button hook support, which is curved so that it resembles a hook, allows the feed to be mounted looking back at the center of the dish. Guy wire kits are available for button hook supports that will provide the additional stability required for reception of both C- and Ku-band signals. Ku-band signals are much higher in frequency and therefore are beamed Earthward in much smaller wave lengths. Consequently, the antenna curvature and location of the feed for Ku-band reception must be much more precise than what C-band systems commonly require.

We recommend that you check to ensure that the feed is centered over the dish by measuring from the lip of the antenna to the edge of the feedhorn's opening at four equally spaced intervals around the antenna's rim. This is especially important if you are using guy wires to anchor the button hook support. If the feed is centered, these measurements will all be equal. If they are not equal, you will have to adjust the tension of the guy wires until the feed is properly centered.

The second type of feed support uses a multi-legged structure to hold the feedhorn and LNB (or LNBs for dual-band systems). These are made up of three ("tripod") or four ("quad") straight, equal length pieces of aluminum or steel. Quad supports are inherently more stable than button hook supports, offering better Ku-band reception. When mounted at the recommended locations on the antenna's surface, these supports should accurately position the feed at the correct focal length: the distance between the center of the dish and the opening of the feedhorn. The correct focal length for your dish is provided in the manufacturer's assembly manual.

Once your system is up and running, you can fine tune the focal length for its optimum position by moving the feed in and out in small increments while watching the receiver's signal strength meter. This is easier to do with a button hook



You also can compute the focal length (f) of any parabolic antenna by using either of the following formulas:
$f = R^2/4d$ or $f = D^2/16d$, where R^2 = radius of the antenna in inches, squared; D^2 = diameter of the antenna in inches, squared; d = depth of antenna in inches.

FIG. 7-13. DETERMINING THE FOCAL LENGTH OF ANY DISH.

than a quad support. This adjustment is particularly important if you are having trouble receiving Ku-band satellite signals.

You can compute the focal length if you know the diameter of the dish along with its f/D ratio. Focal length = the antenna diameter times the f/D ratio. For example, the focal length of a 10 foot antenna with an f/D ratio of .45 equals 10 x .45 = 4.5 feet (54 inches).

To determine the antenna's diameter, measure across the surface of the dish from one side to the other. The radius equals one half the diameter. The depth of the dish is the distance from the center of the dish to the plane of the rim. Stretch a string across the antenna's rim so that it crosses in the center of the dish. The depth will be the distance from the antenna's center to the string.

Many feeds today have adjustable scalar rings. These feeds can be broken down into two parts: a round flat "scalar" plate with concentric circles on its surface and the wave guide onto which the LNB is mounted. This wave guide (technically referred to as an "orthomode coupler") fits into the center of the scalar plate and can be adjusted inward and outward.

The distance that the wave guide extends beyond the surface of the scalar plate must be set to correspond to the f/D ratio of the antenna. Consult with the manufacturer's assembly directions or use the formula provided above to determine the correct f/D ratio of your antenna.

The wave guide may be marked to indicate the various f/D ratio settings. Alternatively, the feedhorn may come with an adjustment gauge for setting the correct location of the scalar rings.

Another thing to check: the plane of the feed opening should be the same as

the plane of the rim of the dish. You can use your inclinometer to check to be sure that both the feed opening and the antenna's rim are parallel with each other.

RUNNING THE CABLE

In most cases it will take three sets of wires to hook up your system: the coaxial cable from the LNB to the receiver, a three conductor wire from the servo motor of the feedhorn to the servo motor control on the back of the receiver, and a four or five conductor wire from the actuator motor at the antenna to the control terminals on the back of the receiver or actuator power supply. We will examine each of these wires in detail in the following sections.

The best way to acquire these wires is to purchase an all-in-one direct burial satellite cable from your retailer at the time you purchase your system. Bury the cable in a trench deeper than any frost line and you are ready to go.

Make sure that you purchase more than enough cable to complete the run all the way from the feedhorn on the antenna, down the pole, in the ground from the pole to the house, up the wall, through the attic, and down an interior wall (which is not always, but often times, the case), while leaving enough left over to easily reach to the back of the receiver. It is possible, but not desirable, to splice an extra few feet onto your cable if you do come up short or decide to rearrange the furniture in the future.

Before connecting all of these cables, however, self-installers should consider temporarily using a short piece to connect the receiver and TV to the outdoor electronics right out at the dish. This method for aligning the dish allows you to make tracking adjustments to the antenna while viewing TV signals and watching the receiver's signal level indicator. If you are going to have a technician during the final stages of the installation he will have a portable meter to use at the dish. Two people also can talk back and forth via walkie talkie or portable phone while one makes adjustments to the dish and the other keeps an eye on the quality of the reception.

Direct burial satellite cable is available containing either one or two coaxial lines. The direct burial cable with two coaxial lines is essential if you intend to use either a hybrid feed (which requires one C-band and one Ku-band LNB) or a dual C-band feed (which requires two C-band LNBs). We recommend that you purchase the direct burial cable with two coaxial lines even if you initially intend to use only a single LNB. The spare coaxial line will then be in place in the event that you ever want to upgrade your system or encounter problems with the primary coaxial line.

If you intend to have more than two LNBs at the dish, you will need to run separate coaxial lines for each of them. For example, multiple receiver systems

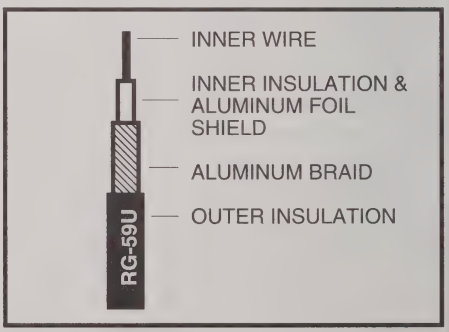


FIG.7-14. COAXIAL CABLE.

with feedhorns which support two C-band and one Ku-band LNB or two C-band and two Ku-band LNBs will need multiple coaxial lines. We go into detail about multiple receiver systems in chapter 11.

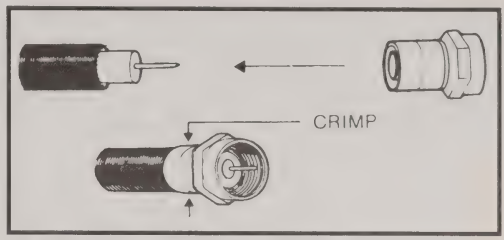


FIG.7-15. F CONNECTORS.

COAXIAL CABLE AND CONNECTORS

You already may be familiar with the cable used for connecting your TV set to the home's master antenna system, a shielded wire called coax (koh-axe, from coaxial). Coax is made up of an inner wire covered with a plastic or foam sheath, and an outer mesh that is in turn surrounded by an outer plastic covering.

A single coaxial cable is used to carry the signal from the outdoor electronics to the indoor receiver. A shorter piece of coax also is used to connect the receiver to the antenna input on the TV. If the programming is to be viewed on other TV sets, the coax cable will first go to a splitter and then on to the various TVs.

A unique type of cable TV connector, called an 'F' connector, is crimped onto each end of the coaxial cable. It mates with complementary connectors on the LNB and indoor receiver. Your local electronic supply house can provide you with the special tool used to crimp 'F' connectors onto the cable. Or you can purchase standard lengths of cable with the connectors already installed. The quality of the F connector is important as some cheaper F connectors break when crimped, providing an additional entry point for moisture as well as a less reliable connection.

When screwing an F connector onto mating connectors on the back of the receiver or LNB, you should take care to avoid bending or breaking the cable's inner conductor, thereby shorting out the connection. There also are right-angle F connectors which can be used whenever space limitations prevent a straight-on connection.

The block IF signal coming from the LNB is no longer a microwave signal. That's why a relatively inexpensive and readily available coaxial cable of small diameter can be used to carry the signal to the indoor receiver. The type of cable commonly used in satellite TV installations has a characteristic impedance rating of 75 ohms. The type of cable used by CB radios and other two-way radio equipment has a characteristic impedance rating of 50 ohms and is not suitable for satellite TV use. Be sure that the cable you buy is 75 ohm coax.

There are several different kinds of 75 ohm coaxial cable available. RG-59U coax can be used to span distances of up to 100 feet. For longer lengths, lower loss RG-6 or RG-11 are used. Direct burial satellite cable contains one or two spans of RG-6. Since RG-6 is slightly larger in diameter than RG-59, it also requires a slightly larger F connector. To span distances of several hundred feet, special UHF line amplifiers with +10 or +20 dB gain also may be necessary to compensate for the amount of signal loss or attenuation that occurs as the signal passes along the length of cable.

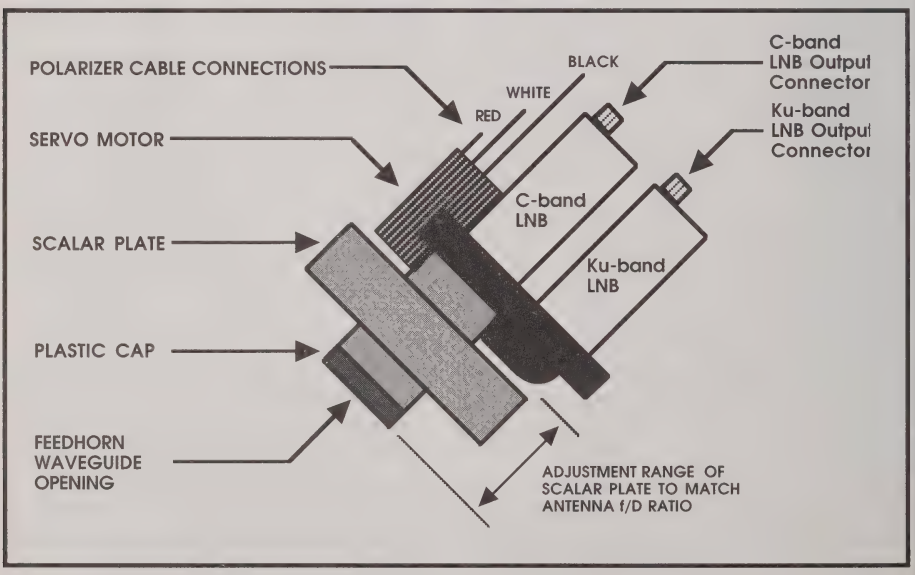
As the block IF frequency range produced by the LNB may extend upwards towards 2,000 MHz, the losses in most types of 75-ohm coaxial cable is very high. These losses can be minimized by using high quality coax from a major manufacturer from Europe or the United States. Some of the cheaper coaxial cable now manufactured in Asia, for example, does not meet the higher performance requirements for satellite TV applications.

The power required to operate the LNB (and any line amps if used) is supplied by the receiver and sent to the LNB via the center conductor of the coax cable. The power stays on even if the receiver is turned off. This keeps the LNB at a more consistent temperature and prevents moisture from condensing inside it. Also available: snap-on waterlock devices which provide an effective way to keep moisure away from the LNB's F connector.

The receiver should be unplugged from the a.c. wall receptacle before connecting or disconnecting the coax cable from the LNB or the receiver. This eliminates the chance of a short circuit across the coaxial connections.

The connection to the LNB (or LNBs for dual-band systems) also should be weatherproofed to keep moisture out. This can be done by flooding the connector with a dielectric silicone sealer or wrapping the connection with a sticky waterproof compound such as Coax-Seal. It is also a good idea to use a plastic LNB/feedhorn cover to give your outdoor electronic components added pro-

FIG.7-16. DUAL-BAND (C/KU-BAND) FEEDHORN/LNB ASSEMBLY—SIDE VIEW.



tection from the elements.

WIRING THE FEEDHORN

The feedhorn line of the direct burial cable is comprised of three color-coded 22 gauge (or larger) stranded wires. These wires also are shielded and jacketed. The three wires provide power, pulse, and ground connections for the feedhorn. Each of these wires connects to corresponding terminals on the back of the receiver. The wires are color-coded to help identify them when connecting to the three servo motor wires at the feed (usually red for power, white for pulse, and black for ground).

A stranded wire is used because it is more flexible and won't break as easily as a solid wire. The shield, an aluminum foil wrapped around all three wires, keeps impulse noises from entering the line and giving false pulses to the receiver. The receiver uses pulses to keep track of the position of the feedhorn's pick-up probe. You therefore can adjust, or "skew", the position of the probe and program the optimum polarization for any given satellite transponder into memory.

The feedhorn's servo motor rotates the pick-up probe, which swings back and forth while switching between the horizontally and vertically polarized transponders (odd and even channels). Keep in mind that there are limits to the pick-up probe's clockwise and counter-clockwise movements. The feedhorn must be aligned on the antenna so that the probe can swing the 90 degrees from horizontal to vertical (or left-hand to right-hand circular) polarization without reaching the limits of its travel. Several manufacturers include a directional guide with their feedhorns to show the proper alignment of the feed when installed on the dish. If you find that you cannot skew the probe beyond a good picture on both the odd and even channels on all satellites, you will need to loosen the clamp that holds the feed onto its support and physically rotate the feedhorn until it is possible to do so.

WIRING THE ACTUATOR

The direct burial cable's actuator line is comprised of five stranded wires. Two 14 or 16 gauge stranded wires are used to power the motor and three color-coded 22 gauge shielded wires connect to the sensor. These actuator wires should be connected to the appropriate terminals on the back of the receiver (or a separate actuator power supply).

Like the servo motor wires, the three shielded motor sensor wires also provide power, pulse, and ground. The vast majority of actuator motors do not require power to be hooked to the sensor. Look inside the actuator housing. If there are only two wires connected to the sensor, then hook up pulse and ground to their respective terminals. If there are three wires connected to the sensor, then hook the 5 volts from the receiver to the red wire on the actuator's sensor, and pulse and ground interchangeably to the other two sensor wires.

The two large stranded wires connect to the large wire terminals at the actuator motor and to the motor wire "1" and "2" terminals on the back of the receiver or power supply. Now try to move the dish to the east or west; if the dish moves in the direction opposite to the one intended, reverse the wires connected to the motor wire "1" and "2" terminals.

Some satellite receivers have an external power supply that puts the large transformer outside of the receiver chas-

sis. This reduces the receiver's size as well as its operating temperature. The power supply is actually a large transformer that turns the local mains a.c. supply voltage (which varies widely throughout the Asia/Pacific region) into 24 to 36 volts d.c. to power the actuator's d.c. motor.

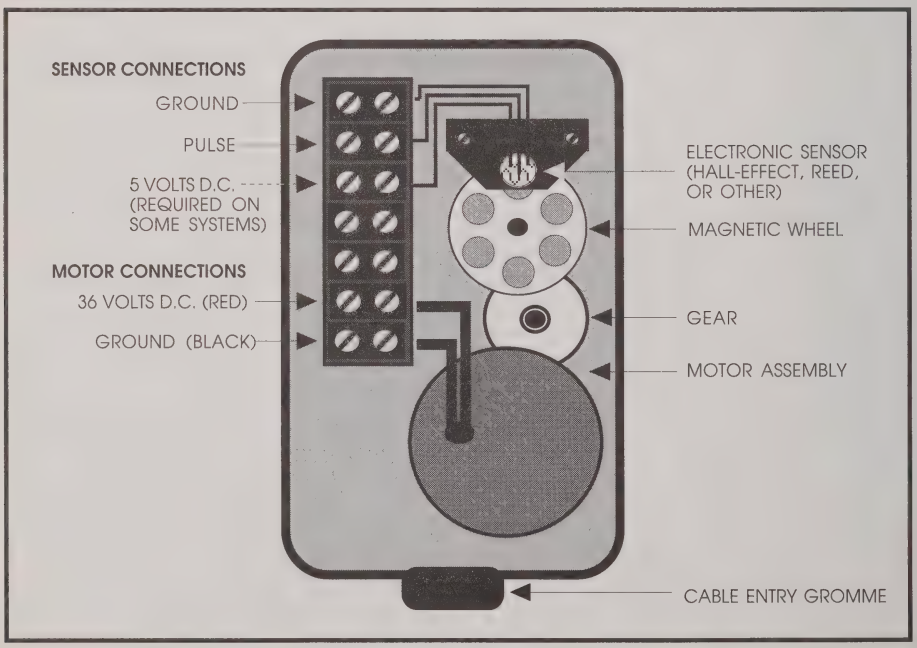
This outboard power supply can be placed behind the TV set or at some other out of the way place. Moreover, in a two receiver system you will not need to purchase a second power supply because only one receiver can control the antenna's position. The receiver with the power supply is then called the "master" while any additional receivers are called "slave" units.

Water intrusion can be a big problem with actuator motors. Be sure to run the wires through the rubber grommet supplied with the actuator to seal off the opening. Also mount the motor so the drain holes are on the bottom to allow any moisture to run out.

GROUNDING THE SYSTEM

If your home's a.c. electrical ground is close to the dish, use a No. 10 AWG or larger solid copper ground wire to connect it to the pipe supporting the antenna. If your dish is physically removed from your home, pound in a separate grounding rod and use a No. 10 AWG or larger solid copper ground wire to connect the pole to it. You should also install an antenna discharge unit or ground block, a passive electrical device that

FIG. 7-17. ACTUATOR WIRING DIAGRAM.



connects in-line between your outdoor electronics and the indoor satellite receiver. To work properly, the ground block should be connected to a ground rod or to the a.c. ground of the house. For added protection prior to a lightning storm—or whenever your system is left unattended and unused for long periods of time—you should **first unplug the satellite receiver from the a.c. wall outlet and then disconnect the incoming coaxial cable(s) from the IF input of the receiver.** After the storm has passed, **reconnect the coaxial cable to the receiver's IF input port before plugging the receiver back into the a.c. wall outlet.** This will help prevent damage due to lightning or related power surges.

There are quick disconnect adapters available which allow you to quickly and easily disconnect all of your indoor components from the rest of the system. You also should use a surge protector on your a.c. line to prevent voltage surges or spikes from setting your receiver aglow.

ATTACHING THE ACTUATOR TO THE DISH

Your dish will have either a horizon to horizon mount or a mount which requires an actuator arm. For "horizon" mounts, the motorized housing will attach directly to a mating flange on the mount. Since there are several steps involved in installing motorized actuator arms we will describe these steps in detail. The principles related to setting the motor's programmable limits will be the same for either style mount.

Before you begin to install your actuator arm, prop the dish up a few degrees with a block of wood or something else which won't damage the antenna. Attach the arm to the dish and the mount

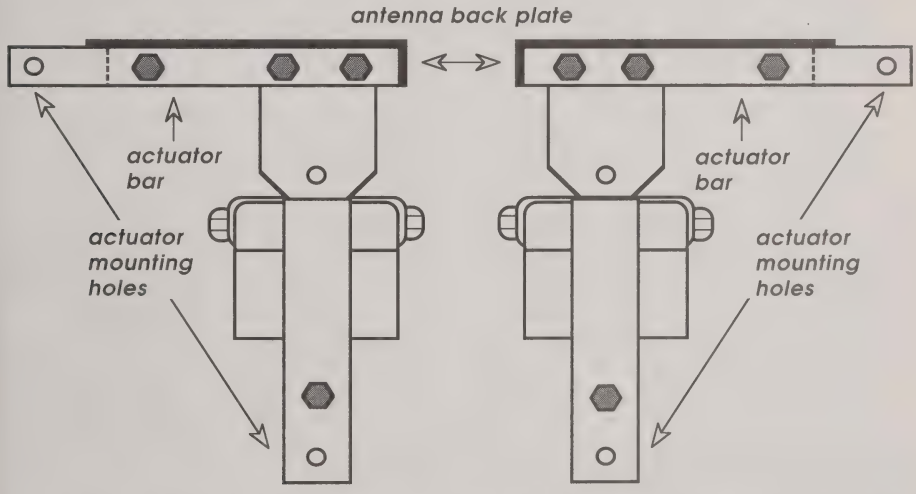


FIG. 7-18. POLAR MOUNT, BACK VIEW. THE ANTENNA ACTUATOR BAR IS OFTEN REVERSIBLE SO THAT YOU CAN INSTALL THE ACTUATOR TO EITHER SIDE OF THE ANTENNA. MOUNT THE ACTUATOR BAR TO THE SIDE THAT HAS THE MAJORITY OF SATELLITES OF INTEREST, OR WHERE AN IMPORTANT SATELLITE IS CLOSE TO THE HORIZON ON THAT SIDE.

as indicated in the manufacturer's assembly directions. The arm attaches on the west side of the dish on systems located in eastern Asia and on the east side of the dish on systems located in western Asia. If you are somewhere in the middle of the region, observe how they are mounted on existing systems in your area or ask your satellite retailer which is the correct method for you.

Refer to the Universal Azimuth-Elevation Look Angle previously presented to find the elevation angle for the satellite that is furthest to the west and furthest to the east of your location. Before tightening the clamp which goes around the arm, use the inclinometer to read the elevation angle of the dish. The arm is at its most retracted position when first installed. You will want the antenna pointed just below the lowest satellite at your location when the arm is in this position. Prop the antenna at this elevation angle and then tighten the clamp on the arm just enough to hold it in place.

DISH ALIGNMENT SETTINGS

You have now completed the basic construction of the dish and are eagerly anticipating your first pictures from space. To fine tune those pictures and get your dish to track, you, or someone you can communicate with, will need to watch the TV screen while adjustments are being made to the antenna. You may even want to bring the TV and receiver out to the dish. If you have purchased a dual-band receiver, be sure that it is set to C-band before proceeding.

At this point, it is best to connect the satellite receiver directly to the TV and not through a VCR, video switcher, splitter, or any other device. The appropriate receiver output connector will be labeled "To TV" or "RF OUT". On most receivers, the output signal can be switched between two VHF or UHF channels. Select the VHF or UHF channel which is not in use in your area. Tune the TV set to receive the selected VHF or UHF channel.

At this point it is a good idea to follow the step-by-step procedures provided in the owner's manual. In most cases, the receiver also will prompt you with instructions that are displayed on the TV screen or on the receiver's front panel.

You first may be instructed to "Set East and West Limits". This is referring to the limits of travel for the actuator arm or horizon drive. Although the motor has a slip clutch to prevent damage when the arm is extended or retracted completely, it is best to set the receiver's programmable limits at positions before the arm reaches these points. Many motors come with built-in limit switches which will shut off the motor at designated points.

Setting the east and west programmable limits. The receiver's programmable limits need to be set to stop the travel of the arm or horizon drive before the built-in limit switches are engaged or before the drive's physical limits are reached. If the arm does reach its full length or is retracted completely the motor's slip clutch will start making loud "clicks". Stop immediately. If the arm becomes stuck in this position, take the motor off and insert the blade of a heavy screwdriver in the slot where the motor engages the arm. Turn the screw driver just enough to loosen the arm, then put the motor back in place.

The idea here is to set the limits so they are just past the last satellite at either

end of the satellite arc but before the mechanical limits of the drive. You can determine the elevation angles for the last satellite to the east and west by using the chart previously provided on page 86.

You may find that, after you have started to receive satellite pictures, you have not left yourself enough room to jog the antenna past the lower or upper satellite (thus making sure you have the best possible picture). In this case you may have to loosen the clamp on the arm and physically adjust it a little, after which you may have to reprogram the limits. An 18-inch arm should be long enough for any 10-foot (3m) or smaller antenna and also most 12-foot (3.7m) antennas. Longer arms are available for larger dishes.

Check to see if you need to reset the limits before programming in the locations of the individual satellites. Otherwise you may delete programming information that you entered into memory prior to resetting the limits.

Setting the polar axis elevation of the dish. Extend the drive until the dish is looking at the highest point in the sky (arc zenith). Set the inclinometer onto the polar axis of the dish. Adjust the polar axis of the mount to the correct elevation angle for your location.

Setting the declination. Declination is the offset angle between the polar axis of the mount and the rim of the dish which permits the antenna to precisely track the Clarke Orbit. The declination angle at any site is determined by the latitude at that location. The declination setting must be adjusted to the figure supplied by the manufacturer for your

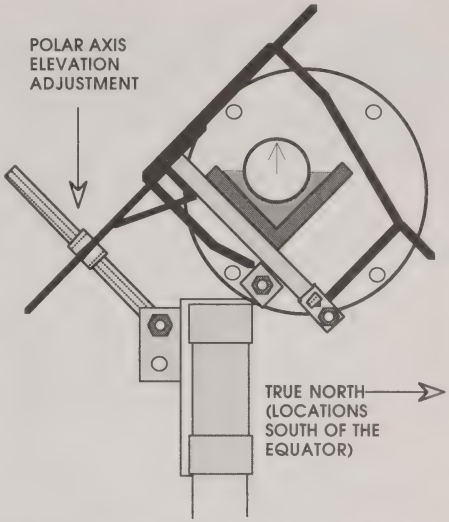


FIG. 7-19. POLAR MOUNT, SIDE VIEW 1. THE INCLINOMETER IS FIRST POSITIONED ON THE POLAR AXIS OF THE MOUNT TO SET THE ELEVATION ANGLE.

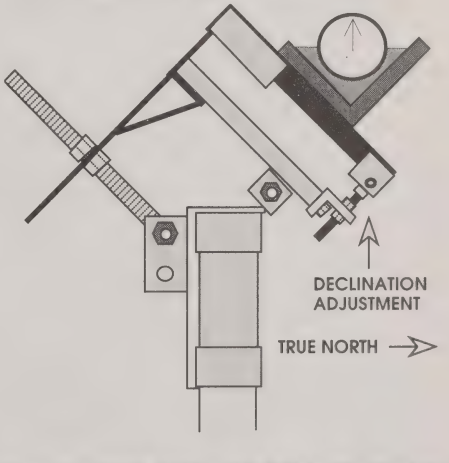


FIG. 7-20. POLAR MOUNT, SIDE VIEW 2. THE INCLINOMETER IS THEN PLACED ON THE ANTENNA CENTER PLATE OR ON SOME OTHER SURFACE THAT IS PARALLEL TO THE RIM OF THE DISH. THE ANGLE HERE SHOULD BE GREATER THAN THE ANGLE MEASURED ON THE POLAR AXIS BY THE AMOUNT OF DECLINATION REQUIRED FOR YOUR LATITUDE.

specific site. If you need to compute the declination you can find out the approximate value by using Fig. 7-22.

With a modified polar mount antenna, correct tracking of the total Clarke Orbit is only possible when the declination has been properly set. Set the inclinometer on the back plate of the antenna (same plane as the rim of the dish). Using the declination adjustments on the mount, set the antenna for an elevation angle that is equal to the polar axis angle plus the number of degrees of declination for your area. The dish should be looking down slightly from the angle of the mount.

TRACKING PROCEDURES

Now is the time to begin tracking the satellites and programming their positions into memory. This is not difficult now that you have everything set. When moving the dish to the east or west, the dish's look angle should now follow a curve similar to that of the Clarke Orbit.

You may have a satellite receiver that was designed to find and program the satellites on its own. However, even these "smart" receivers will require you to find and identify one upper and one lower satellite. There also are automatic dish peaking and polarity peaking features on some receivers. If you choose to use these auto features, first follow the steps presented beginning on page 108 to get your dish to track the Clarke Orbit. Once you are confident that you are receiving your best signal on a lower and upper satellite and have programmed them into the receiver, you are ready to turn on the auto program feature.

The accuracy of these auto features primarily depends on which brand of receiver you have purchased. Some receivers occasionally miss a satellite or two and you often find that you can peak the position of the dish and polarity better manually. It is recommended, especially during the initial installation, that you turn these features off.

Many receivers have a scanning feature that is handy for locating satellites. These receivers scan repeatedly through all of the available satellite channels at a rapid pace, providing you with glimpses of the active transponders. Channels will flash by on your TV screen as you

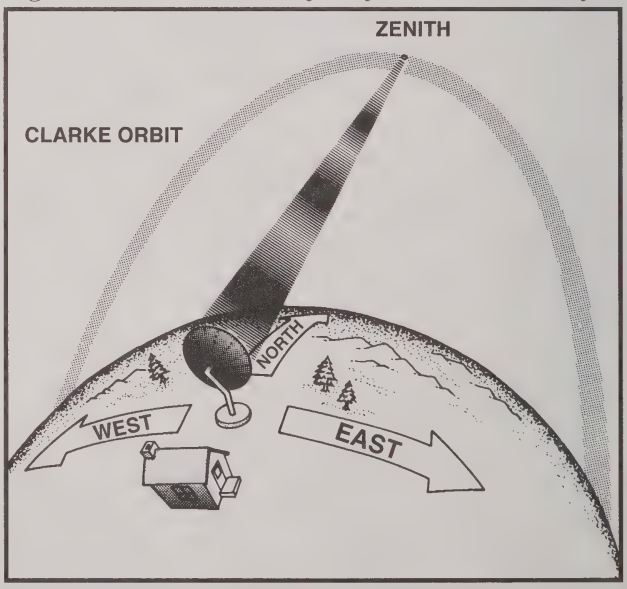
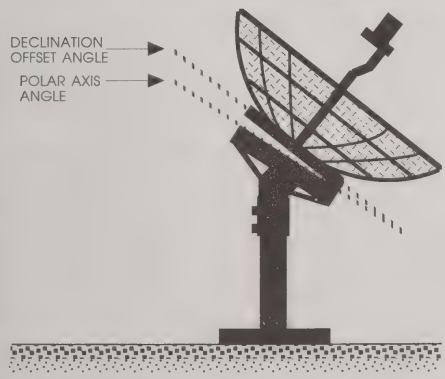
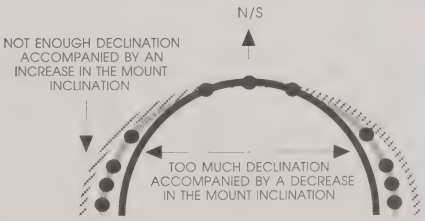


FIG.7-21. ARC ZENITH (FOR LOCATIONS SOUTH OF THE EQUATOR).

FIG.7-22. DECLINATION OFFSET ANGLES (IN DEGREES).

	N. or S LATITUDE	NEARBY CITY/REGION	POLAR AXIS ANGLE	ARC ZENITH	DECLINATION ANGLE
POLAR AXIS ALIGNED WITH TRUE SOUTH	43	Vladivostok	43.72	49.61	5.89
	40	Beijing, China	40.71	46.27	5.56
	37	Seoul, Korea	37.69	42.90	5.21
	35	Tokyo, Japan	35.68	40.65	4.97
	31	Shanghai	31.64	36.11	4.47
	25	Karatchi, PK	25.57	29.23	3.66
	20	Haikou, China	20.47	23.45	2.98
	15	Manila, PH	15.37	17.62	2.25
	10	HCM City, VN	10.26	11.77	1.51
	05	Brunei	05.13	05.89	0.76
	Equator		0	0	0
POLAR AXIS ALIGNED WITH TRUE NORTH	10	Port Moresby	10.26	11.77	1.51
	20	Townsville	20.47	23.45	2.98
	28	Brisbane/ Gold Coast	28.61	32.68	4.07
	31	Perth	31.64	36.11	4.47
	33	Sydney/ Newcastle	33.67	38.38	4.71
	34	Adelaide/ Wollongong	34.67	39.52	4.85
	35	Canberra	35.68	40.65	4.97
	37	Melbourne/ Auckland & Waitemata, NZ	37.69	42.90	5.21
	38	Geelong/ Hamilton, NZ	38.70	44.03	5.33
	39	Napier-Hastings	39.70	45.15	5.45
	41	Wellington, NZ	41.71	47.38	5.67
	43	Hobart/ Christchurch	43.72	49.61	5.89
	45	Dunedin, NZ	46.71	52.92	6.22





To accurately track the available satellites from your location, you must adjust the mount to the correct declination AND polar axis settings.

FIG.7-23. EFFECTS OF DECLINATION ADJUSTMENT.

move the dish past a satellite. You can go back to where the flashes occurred, turn off the scan feature, and identify the satellite by comparing the programming you encounter to the satellite TV program grids which appear in Appendix B. Some satellites only carry a few active transponders. Without the scan feature, you would need to select an active transponder and tune to the correct polarization before you could find the satellite.

Preview the sections in your receiver manual on dish set-up and programming. Also read through these next steps to get familiar with the overall procedure you are about to perform. Finally, initiate each of the steps below.

Inclinometer readings for the satellite look angles (the elevations of the satellites available in your area) should be taken on the back plate of the antenna or on a surface parallel to the plane of the rim of the dish.

1.) Determine the elevation of the lowest satellite available from your location and move the dish until the inclinometer registers that elevation.

2.) Engage the receiver's scan feature or set the receiver to a channel which should have programming on it. A 24 hour service, even if it is scrambled, would be a good choice. Refer to a current satellite program guide to find a suitable selection.

3.) Push the dish to the right or left so that it rotates on the pole until you see a flash of video on your TV screen. Turn off the scan and go through the channels until you find video.

If the video seems to zip off the screen as soon as you stop on the channel try changing the receiver's polarization format. That is, if you have your odd channels set for vertical polarization and your evens for horizontal, change the format to odds-horizontal, evens-vertical. You may not even know the present polarization format for your system. A change in format changes the relationship of the feedhorn's pick-up probe by 90 degrees. If changing the format keeps the video on the screen, then it has to be the correct setting for that satellite on your system.

Select the best skew setting for the odd and even channels.The skew is the fine tuning of the feedhorn's polarization, required because the satellite's signal polarization is only truly "horizontal" or "vertical" when the satellite is positioned at the same longitude as the installation site. The skew and format buttons are found either on the front of the receiver or on the remote control. Many receivers with on-screen graphics require you to choose these functions on the menu.

Most receivers have a LED signal level indicator on the front panel or a digital level indicator presented by on-screen graphics. The level indicator provides a better reading of peak satellite perfomance in contrast to just viewing the picture on the TV screen.

4.) For locating satellites in the lower section of the Clarke Orbit, push the dish right and left on the pole and move the drive east and west in slight increments until you are satisfied you have the strongest signal. Then tighten the mount's bolts onto the pole so that the dish won't rotate. Do not tighten them down firmly yet, however. Note the numerical reading provided on the receiver's

front panel or on-screen display that corresponds to dish position at this location. This is a relative number that changes as the dish moves.

5.) Move the dish east or west until you reach arc zenith for your location. Select an active transponder for the satellite closest to the east or west of arc zenith or turn the scan control on. Now move the dish in the direction of the nearest satellite. If all the settings have been done right you should not have a problem finding it.

6.) For locating satellites that are in the upper section of the Clarke Orbit, jog the actuator drive east and west and adjust the elevation bracket (on the mount of the dish) up and down slightly. You should not have to move the elevation setting very much because you already have pre-set it for your location. The rule of thumb here is:

Rotate the dish on the pole and use the actuator to receive lower satellites, but do not rotate the dish on the pole to receive upper satellites. Adjust the elevation of the dish and use the actuator to receive upper satellites, but do not adjust the elevation to receive lower satellites.

7.) Fine tune your tracking by repeating these steps until the satellites in both the upper and lower sections of the Clarke Orbit appear at their maximum signal strength without requiring any further adjustments. If this cannot be done, you have probably made a miscalculation in the elevation or declination settings. Once you have the dish tracking properly, firmly tighten the bolts that secure the mount onto the pipe. Placing a bolt all the way through the pipe may be desirable in high wind areas. Mark the pole and the mount for later reference.

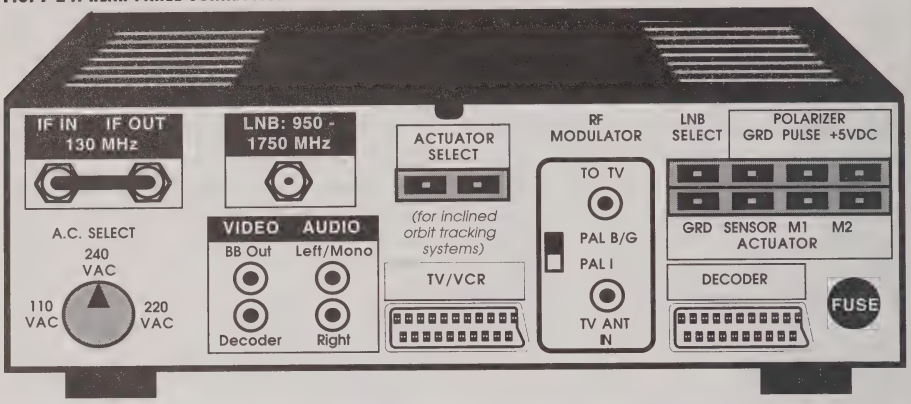
THE FINAL CONNECTION

The final connection is from your satellite receiver to your TV set. We mentioned above that you can hook up a coaxial cable directly from the "To TV" ("RF Out") output of the receiver to the "Antenna" input of the TV set. Your local antenna wire, which formerly was connected directly to the TV set, should now be connected to the "Antenna" input on the back of the receiver. To watch local channels, turn the satellite receiver off and the local channels will automatically appear on their respective channels on the TV.

If your satellite receiver does not have this feature, you will need to purchase an A/B switch from your local satellite or electronics store. Both the satellite receiver and local antenna connect to the "A" and "B" input ports on this switch, while the single output port connects to the antenna input on the TV. This switch will have to be changed manually whenever you want to go from one to the other. You also will need to use an external A/B switch if a second TV is connected to the satellite receiver and one person wants to watch local TV while the other is watching a satellite TV program.

There are other options when it comes to connecting the satellite system to your TV set or home theater system. There are video and stereo audio outputs on the back of your receiver. These can be connected directly to a TV monitor or to a VCR for recording programs. Whenever a VCR is part of the overall

FIG. 7-24. REAR PANEL CONNECTIONS FOR AN INTERNATIONAL SATELLITE TV RECEIVER.



IF In/IF Out. *Optional connections for external filters. When not used, the "IF In" and "IF Out" ports are connected by a short coaxial jumper cable supplied by the manufacturer with the receiver.*

A.C. Select. *Some receivers feature selectable A.C. voltage for operation anywhere in the world. Be sure to select the correct mains voltage prior to plugging in the receiver to an A.C. power outlet.*

LNB. *The coaxial cable from the LNB connects here.*

Video/Audio. *The "BB" (short for baseband) video connector supplies a video output signal for connection to a TV monitor or VCR. The "decoder" connector is for supplying a signal to an external decoder. "Left/Mono" supplies the left speaker audio signal for connection to a stereo TV, stereo VCR or home entertainment system; or the monaural audio signal. "Right" delivers the right stereo audio signal.*

Actuator Select. *Option for satellite antennas with two actuators.*

TV/VCR and Decoder. *European SCART connectors for connection to TV sets, decoders and other electronic devices with SCART capabilities.*

RF Modulator. *The "To TV" connector delivers the satellite TV signal to TV sets which do not have a video input port. The "PAL" switch allows users to select the type of PAL which is compatible with their TV sets. The home's terrestrial TV antenna plugs into the "TV Ant" port.*

LNB Select. *Supplies a switching voltage to an external accessory for connecting two LNBs to the receiver.*

Polarizer. *The "Ground" (black), "Pulse" (white) and "5 Volts D.C." (red) wires from the feedhorn connect here. Feedhorns with a ferromagnetic type polarizer only use the "Ground" and "Pulse" connections.*

Actuator. *The light gauge wires from the actuator's sensor connect to the "Ground" and "Sensor" ports, while the heavier gauge motor wires connect to "M1" and "M2."*

FIG.7-25. "...AFTER THAT WE WANT TO SEE CARTOONS AND PLAY A VIDEO GAME, THEN WE WANT TO WATCH THE CHANNEL [V] SATELLITE, AND DON'T FORGET MOM WANTS TO RECORD A MOVIE ON STAR PLUS AT FOUR."

entertainment system, the output of the VCR must be connected to the TV set and the local antenna is usually also connected to the "Antenna" input of the VCR.

The satellite receiver's stereo audio outputs can be connected directly to the stereo inputs of the TV set or to the auxiliary inputs of your stereo system's audio amplifier or tuner. For hooking up more than one TV set in the home to the satellite TV system, see chapter 10.

THE SCART CONNECTOR

Developed by the French, the SCART (for Syndicat des Constructeurs d'Appaleils Radio Recepteurs et Televiseurs) connector was developed in part as a standard for making connections between various audio and video products in the home entertainment system. The SCART connector, also known as the Peritel or Euro-Connector, subsequently was adopted as the standard audio/video interface connector by most countries in western Europe.

One or more SCART connectors are now found on most satellite receivers, IRDs, and decoders manufactured for the European market. What's more, TV sets sold in the European market have one, two, or even three SCART connectors! The SCART connection is advantageous for displaying video of the best possible quality on top-of-the-line TV sets. The TV output of the satellite receiver is available in three modes: RF (for connection to the UHF antenna jack on the TV set or VCR, composite video (for connection to a VCR's video input or SCART connector or a TV/monitor's video input jack), or RGB (Red-Green-Blue plus sync)—for connection to the separate R, G, and B circuits within the TV

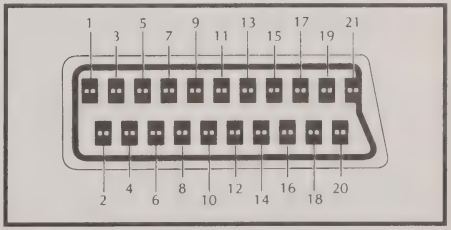


FIG. 7-26. SCART CONNECTIONS.

FIG. 7-27. SCART CONNECTOR PIN CONFIGURATION. NOTE THAT PINS 10 AND 12 ARE USED FOR INTERFACING PERIPHERAL EQUIPMENT BY TRANSFERRING CONTROL DATA FROM THE HOST EQUIPMENT TO THE PERIPHERAL DEVICES.

1	Right Audio Out	13	Red Earth
2	Right Audio In	14	Intercommunications Earth
3	Left Audio Out	15	Red In
4	Audio Earth	16	Fast RGB Blanking
5	Blue Earth	17	Earth for composite video, synch & blanking
6	Left Audio In		
7	Blue In	18	Fast blanking Earth
8	Source Switching	19	Composite Video Out
9	Green Earth	20	Composite Video In
10	Interconnection	21	Socket Earth
11	Green In		
12	Intercommunication		

set or TV monitor. The SCART connector can supply both composite video and RGB plus sync. SCART even provides a control line that automatically connects the TV set to the appropriate video source, such as a SCART-equipped VCR or satellite TV receiver, as soon as that video source has been turned on.

Since a direct RGB connection can be made between the satellite TV receiver, VCR, and TV, the visual imperfections associated with composite video are eliminated. SCART control centers and splitters with stereo audio output connections also are available to enable TV audio sound to be played through the home stereo entertainment system.

Manufacturers of specialist Audio Video equipment and instrumentation sometimes re-allocate SCART pin functions to squeeze additional functions from their equipment through the SCART connector. If the SCART connections don't function as expected, please check the equipment manufacturers instructions for the SCART pin out diagram.

Encryption, Digital Compression, & High Definition Television (HDTV)

Encryption is an electronic means of rendering the images and sound track of a TV service unintelligible except to those receiving terminals which are authorized to view the signals; all other receiving stations intercepting the encrypted TV service are unable to access the video and/or audio programming. In addition to providing program service providers with security against unauthorized reception, encryption systems also offer the technical means whereby a programmer can authorize and bill its subscribers.

TV service providers spend huge sums of money to independently produce programs or to obtain the rights to show programs produced by other companies, and therefore have a right to receive fair compensation for the viewing or other use of their programming. On the other hand, programmers have a responsibility to provide TV viewers with reasonable access to any TV program distributed via the public air waves for which the viewers are willing to pay a reasonable subscription fee. This is especially important for those viewers who live in areas where home satellite TV systems provide the only means by which they can view these TV programs.

Because many satellite TV services are advertiser-supported, they are transmitted in the clear and free-of-charge. National broadcast networks from various countries within the region also are unencrypted. However, other programmers in the region—including CNN International, ESPN, and the American Forces Radio Television Service (AFRTS)—have encrypted their services to prevent unauthorized reception.

INTEGRATING THE DECODERS

With the development of the integrated receiver/decoder or IRD, the decoder required for receiving encrypted TV programming has been rendered transparent to the operator. There are several other compelling reasons for placing the decoder inside the receiver. Since the IRD's microprocessor is in charge of all system functions, the operator can use one hand held keypad to control the entire system, including the decoder module.

Due to the digital audio capabilities of the decoder module, the latest IRDs can deliver superb stereo audio performance from encrypted TV program services. Audiophiles also enjoy the great number of encrypted digital audio services also available via satellite.

Many of the TV services now available via satellite are encrypted. It therefore is important to know a few facts about how decoders and IRDs operate. IRDs have been available in the Australian marketplace for more than seven years. The ABC and SBS national television net-

works and regional TV networks such as Golden West, Queensland Satellite TV and Imparja, are available to satellite TV viewers equipped with a B-MAC IRD.

B-MAC, a unique television transmission format with enhanced capabilities over the PAL video standard, is used to transmit these signals to Australian satellite TV viewers. Some B-MAC signals available in Australia are sent in an "open key" mode which allows any PAL B-MAC compatible IRD to receive the broadcasts without obtaining authorization. Australian satellite TV services using B-MAC such as sporting channel Sky TV, are encrypted and each IRD must receive a specific authorization message from the up-linking station before it can receive the service.

THE B-MAC TRANSMISSION SYSTEM

Scientific Atlanta's B-MAC (Multiplexed Analog Component—Type B) video encryption system integrates a TV program's video and audio, as well as any accompanying teletext or other data information, into a single integrated TV signal. In addition to the many services on Australia's Optus satellites which use B-MAC, international programmers using the INTELSAT and Palapa satellites also are using B-MAC to distribute their signals to authorized outlets in Asia, the Middle East, and the South Pacific.

While B-MAC does supply these abovementioned services with signal security and the means for addressing a large number of individual receiving stations, it is not just another encryption system. B-MAC also achieves a higher level of signal performance at low carrier-to-noise levels when compared to a standard PAL TV transmission. This capability permits satellite TV viewers to use smaller, less expensive receiving antennas to pick up the programming. In

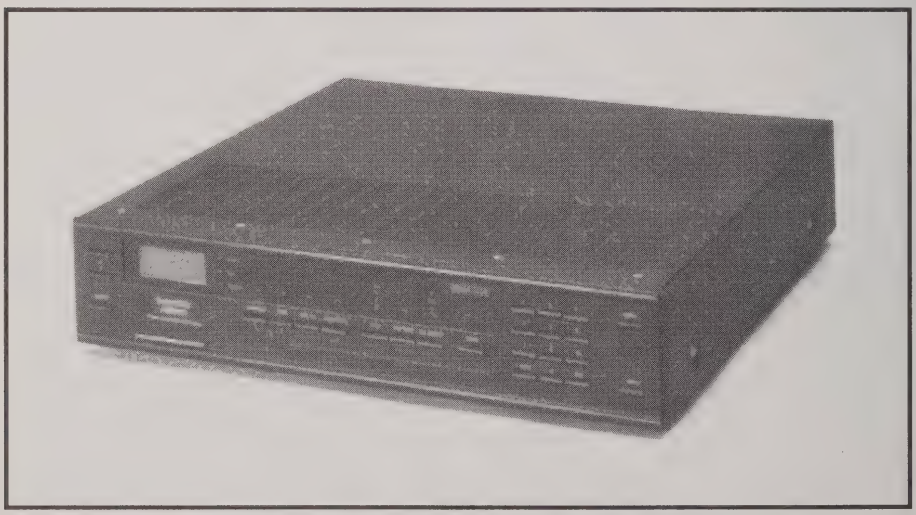


FIG.8-1. B-MAC DECODER FOR PAL AND NTSC STANDARDS. (COURTESY SCIENTIFIC-ATLANTA.)

addition to transmitting video, a single B-MAC signal also can deliver up to six high-quality digital audio signals, one utility data channel and teletext—all over a single satellite channel.

PAL simultaneously transmits the chrominance (color) and luminance (brightness) components of the video signal. With PAL, these two components can interact with each other, introducing unwanted video distortions called "artifacts." B-MAC improves on PAL by sequentially transmitting the color information in one-third the active scanning time of each horizontal line of the video frame and the monochrome information in two-thirds the active scanning time. Since the chrominance and luminance components are not transmitted at the same time, no artifacts can occur. B-MAC video performance is further improved by the use of a digital sync pulse.

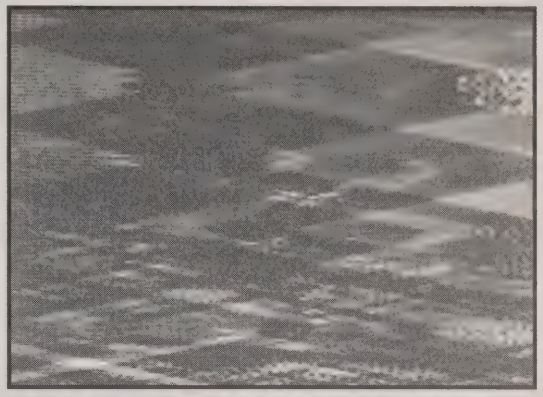


FIG.8-2. B-MAC ENCRYPTION. (COURTESY SCIENTIFIC-ATLANTA.)

The individual lines contained in B-MAC's vertical blanking interval (VBI) carry various other information. Line one transports the digital clock recovery signal, line two carries the digital sync recovery signal, line three sends the system data, lines four through nine handle the address data packets, and lines 10 through 15 hold the teletext packets. The horizontal blanking interval (HBI) provides the capacity for as many as six digital audio channels and one utility data channel.

B-MAC uses an encryption technique called line translation to provide a reasonably high level of signal security.

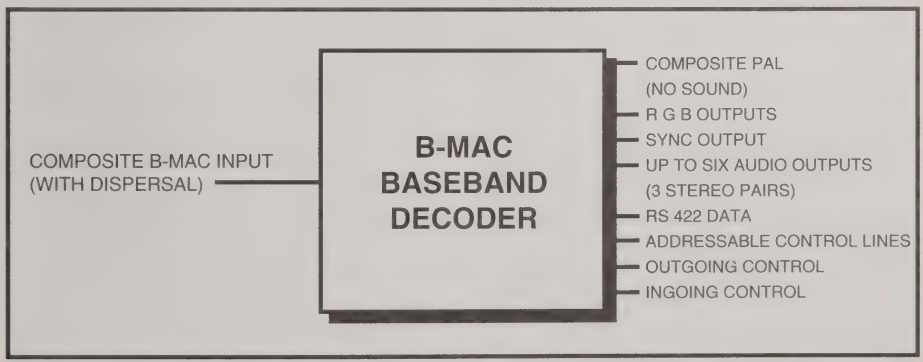


FIG. 8-3. B-MAC BASEBAND DECODER INTERFACES.

CHANNEL A:	ABC TV stereo audio (Right + Left)/2
CHANNEL B:	ABC Radio 2 (monaural)
CHANNEL C:	ABC Radio 3 (monaural)
CHANNEL D:	ABC TV stereo sound (Left)
CHANNEL E:	ABC Radio 4 (Stereo—Right)
CHANNEL F:	ABC Radio 4 (Stereo—Left)
TELETEXT:	ABC Teletext Service

FIG.8-4. TV AUDIO, AUXILIARY RADIO AND TELETEXT SERVICES FOR THE HCBSS DIRECT TO HOME SERVICES ON OPTUS B1 ARE TRANSMITTED WITHIN THE B-MAC SIGNAL'S HORIZONTAL BLANKING INTERVAL.

With line translation, the timing for each line of the video image is delayed by several microseconds. This is what generates the readily identifiable diamond hatched pattern that unauthorized viewers see when tuning into a B-MAC encrypted service which they have not yet been authorized to view.

The digital algorithm or electronic "key" to the line delay pattern for any service can be changed at frequent intervals, making a one-time cracking of the code exceedingly difficult. Only those terminals equipped with B-MAC decoders which are individually addressed via a packet of data contained in the vertical blanking interval can switch on and decode the signal.

VIDEOCRYPT I & II

Jointly developed by Thomson Consumer Electronics and News Datacom, STAR TV uses Videocrypt II (NTSC) to transmit its STAR Movies service on AsiaSat 1's northern beam with TNT/The Cartoon Network using Videocrypt I for their Apstar 1 service. The following description of the Videocrypt system will provide readers with a basic understanding of the encryption process.

Both versions of Videocrypt and STARcrypt (STAR TV's Schlumberger based encryption system for it's PAL movie service on AsiaSat 1's southern beam) employ the "active line rotation" or "cut and rotate" principle where every line of the picture is cut at any one of a number of points along its length, chosen at random by a Pseudo Random Binary Sequence (PBRS) generator. The two resultant line halves are then stored prior to being transmitted in reverse order. As the cut points are randomly different from each other, the result is a display having no viewing value whatsoever. On reception, the lines as transmitted are again stored, but subsequently delivered so that the true start of the unencrypted line is always first out for display. The two halves therefore are correctly and imperceptibly rejoined into their original order for an error-free picture.

Before this simple process can be put into effect, the subscriber's decoder or IRD must have instantaneous and accurate knowledge of the cut point on each of the transmitted lines. Details about the position of these points is provided via the encryption process. An essential decoder requirement is that it also must contain a Pseudo Random Binary Se-

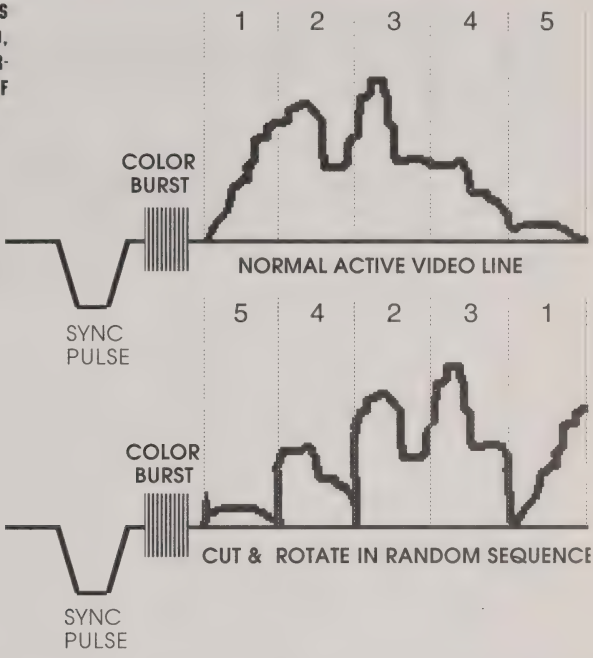


FIG. 8-5. VIDEOCRYPT ENCRYPTION IS BASED ON THE CUT AND ROTATE METHOD, WHICH SLICES EACH LINE OF VIDEO INFORMATION AND ROTATES THE POSITION OF EACH SEGMENT IN A RANDOM ORDER.

quence (PBRS) generator which reflects the characteristics of that programmed within the uplink's encryption equipment, allowing the uplink and downlink units to be brought into synchronization. Central to the Videocrypt encryption system is the randomly generated numerical "key"—a final control algorithm which can be changed by the system control managers periodically.

Because the uplink encoder periodically interrupts and restarts the final control algorithm, the decoder must be told just when and where to restart as well. This instruction is referred to as the "seed". This seed must be sent to the subscriber in order to keep the decoder dynamically locked to the PRBS at the uplink end.

In the Videocrypt system, a new seed is generated periodically and sent over-the-air to each authorized subscriber decoder or IRD within the satellite TV

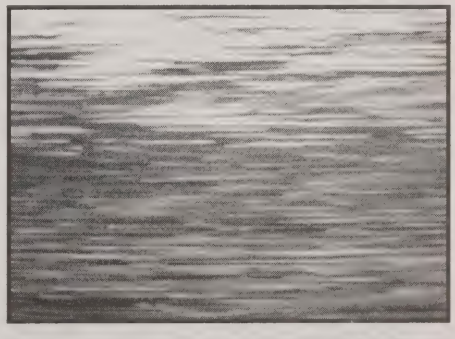


FIG. 8-6. VIDEOCRYPT LINE ROTATION SYSTEM AS TRANSMITTED ON THE APSTAR 1 SATELLITE (TNT/THE CARTOON CHANNEL.)

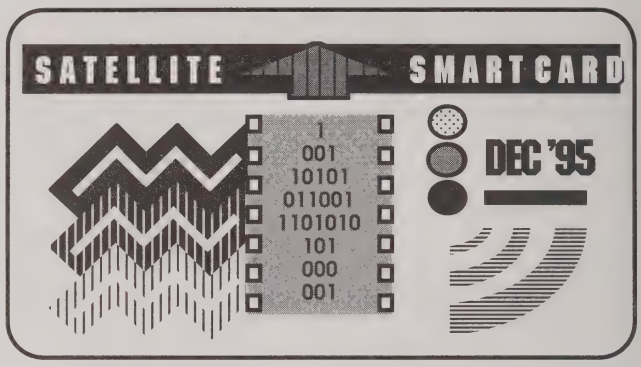


FIG. 8-7. THE MASTER ELECTRONIC KEY OR ALGORITHM IS SUPPLIED TO THE DECODER BY THE SUBCRIBER'S SECURITY CARD—A SMALL RECTANGULAR PIECE OF PLASTIC ABOUT THE SIZE OF A CREDIT CARD WHICH CONTAINS SOLID-STATE ELECTRONIC CIRCUITRY.

signal's vertical blanking interval (VBI). The seed is encrypted to ensure that only authorized subscribers can receive it.

Once transmitted and received by the subscriber's decoder or IRD, the seed must be reconverted into a form which is understandable to the unit's own PRBS. To accomplish this, a reverse form of the master electronic key or algorithm is supplied to the decoder by the subscriber's security card, which stores the appropriate algorithm inside a solid-state electronic chip that is embedded within it.

DECODER PROBLEMS AND THEIR SOLUTIONS

Satellite TV systems which previously have been receiving satellite TV services that broadcast in the clear often experience problems following the installation of a decoder for reception of encrypted pay TV services. Many individuals have been sold a relatively small aperture antenna in order to reduce system cost or fit into a restricted space. Because a small antenna is used, the system produces marginal TV signals, i.e. signals which have some noise or "sparklies" in the picture. Reception of encrypted satellite TV services requires a robust signal that exceeds the threshold performance level of the satellite receiver. If the decoder receives a signal that is at or below threshold, data errors are produced and the decoder is unable to determine the correct reference points to reassemble the encrypted signal. For example, the video's horizontal sync pulse is the only reliable part of the video signal from which the cut points can be determined in a line rotation encryption system. Insufficient signal reaching the receiver can result in a sparklie appearing in or near the horizontal sync pulse. This will cause the decoder to lose its reference point for reassembling a line of video.

One obvious solution is to install a larger, more efficient antenna. It also may be possible to increase the signal performance of the satellite TV receiving system by installing a new LNB with a lower noise temperature rating.

Other causes of data errors include adjacent satellite interference (where signals from a nearby satellite are received simultaneously with the signals from the desired satellite), terrestrial microwave interference, and reflected signal between the LNBF and receiver resulting

from low quality line amplifiers, splitters, or cable. In many instances, these problems can only be solved by using a larger receiving antenna, or replacing the coupling electronics. Problems involving adjacent satellite interference sometimes can also be solved by fine tuning the polarization skew of the system to reduce the adjacent satellite interference to acceptable levels. Solving terrestrial interference problems is mentioned on page 142.

Not all receivers provide the required video levels or the correct video de-emphasis circuitry to drive a decoder. For example, too low a video level or an incorrect receiver de-emphasis network may place the data close to the point where the decoder determines if the data is a one or a zero. As there would be some noise on the signal, the combined effect could result in intermittent bad data. If contemplating the installation of a decoder for pay TV reception, check with your satellite retailer to be sure that your current receiver will work with the decoder for the service which you intend to view.

VIDIPLEX AND E-PAL

Two additional nonstandard satellite transmission formats have also been used by Australian TV broadcasters. The Vidiplex transmission system has been used to send U.S. cable and broadcast TV programming to Australia via an INTELSAT satellite located over the Pacific Ocean. Vidiplex is not really an encryption system. It should rather be regarded as a simple analog compression system which allows two conventional PAL TV signals to be transmitted simultaneously over the frequency bandwidth of one TV channel.

A complete PAL video picture or "frame" consists of two separate "fields", with "field 1" consisting of the odd-numbered lines in each frame and "field 2" the even-numbered lines in each frame. The two fields alternate at such a high speed—50 times per second—that the human eye perceives the two separate fields as a single unified whole. This process of using two separate fields to produce an image is known as interlaced scanning.

The Vidiplex transmission system uses "field 1" to transmit one TV service and "field 2" to transmit a second TV service. Standard satellite TV receivers tuned to a satellite transponder using Vidiplex receive both TV services simultaneously—an unpleasant viewing experience at best. Through the use of a Vidiplex decoder, however, either field can be selected for viewing while the additional field is ignored.

The E-PAL encryption system has been used by Australia's three commercial terrestrial television services for many years to encode their main network program feeds over the Optus satellites. Decoders are available that provide a picture only, as the accompanying audio is digital.

COMPRESSED DIGITAL VIDEO (CDV)

Compressed digital video (CDV) is a new kind of transmission method that can transform a conventional TV signal into a shorthand version that dramatically reduces the amount of frequency bandwidth needed to broadcast the signal. This new technology has made it possible for satellite operators to transmit multiple TV signals within the amount of frequency spectrum previously used to relay a single TV channel.

By using digital video compression, a

single satellite transponder can accommodate the simultaneous transmission of up to eight video program services. Digital video compression also uses advanced techniques to produce laser disc quality video and compact disc quality stereo audio.

To receive digitally compressed video signals, you will need to have a special all-digital integrated receiver/decoder or IRD that is compatible with the transmission format used by the satellite service or services which you desire to view. At the time of writing, several Asian programmers were using compressed video technology, including BBC World Service TV; ABS-CBN, Chinese TV Network, Prime International, Country Music TV (PAS-2), and TVB (Apstar 1 and Palapa B2P). Most of these above mentioned services provide consumer IRDs for direct-to-home reception. However, STAR TV launched a multichannel, compressed digital video TV program package on Asiasat 2 in 1996 which is available to consumers in selected markets. The Asiasat 2 coverage beam includes Australia and New Zealand.

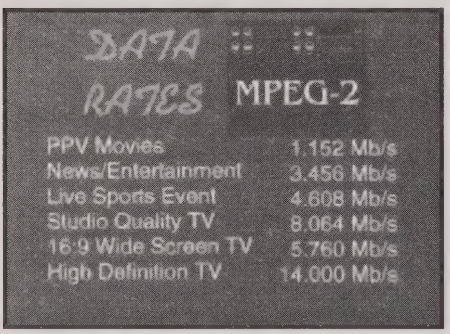


FIG. 8-8. THE MPEG-2 DIGITAL VIDEO COMPRESSION STANDARD USES DIFFERENT COMPRESSION RATES, DEPENDING ON THE TYPE OF PROGRAMMING TO BE TRANSMITTED. (COURTESY SHELBURNE FILMS.)

DIGITAL COMPRESSION SYSTEMS

Digital Video Broadcasting (DVB) is a group of 180 broadcasters, manufacturers, conditional access providers, trade associations and governments, from 18 countries, who have overcome the hurdles of compatibility to agree upon the DVB compliant MPEG2 (Motion Picture Experts Group) standard.

Deutsche Welle, the German National broadcaster, commenced transmission of a digitally compressed "bouquet" of five European TV channels, and up to twenty European radio stations using a single AsiaSat2 transponder in May 1996. TV stations such as music video channel *MCM* and *TV5* of France, *RAI Uno* Italy and *TVE* Spain, are the most likely candidates to join *Deutsche Welle's* digital bouquet. Best of all, the new digitally compressed European Bouquet is being delivered in an open key DVB compliant MPEG2 mode for which no subscription fees will be required. These services can be received by any DVB compliant MPEG2 satellite receiver.

Australia's Galaxy Pay TV service was the first in the world to use a DVB compliant MPEG2 transmission standard for their DTH satellite Pay TV service, which commenced late in 1995. Viewers benefit from outstanding picture quality and smaller dish sizes, whilst the broadcaster makes considerable savings in the cost of transponder bandwidth. Galaxy is the Australian licensee for the Dutch IRDETO conditional access system, which locks out unauthorized viewers from all but shopping channel The Value Channel. Subscribers can view other open key DVB transmissions with the same receiver. An IRDETO equipped receiver is not able to access

FIG. 8-9. SATELLITE TV PROGRAMMERS IN THE ASIAN/PACIFIC REGION USING OR PLANNING TO USE COMPRESSED DIGITAL VIDEO.

Programmer	Satellite	Orbit
BBC World Service TV	PAS-2	169° E
Chinese TV Network	PAS-2	169° E
Country Music TV	PAS-2	169° E
Encore	PAS-2	169° E
The Filipino Channel	PAS-2	169° E
National Tech. Univ. (NTU)	PAS-2	169° E
Prime Sports	PAS-2	169° E
ABS/CBN	PAS-2	169° E
TVBS	Apstar 1	138° E
Goldsun Satellite TV	Palapa-Pac	134° E
One Leader Music TV	Palapa-Pac	134° E
Taiwan Satellite TV	Palapa-Pac	134° E
Rainbow Channel	Palapa-Pac	134° E
People's Network	Palapa B2P	113° E
TVBS	Palapa B2P	113° E
STAR TV	AsiaSat 2	100.5° E
Deutche Welle & friends	AsiaSat 2	100.5° E
IBC/Thai Sky	Thaicom 1/2	78.5° E
Australian Pay TV	Optus B3	156° E

digital broadcasts that use other conditional access systems, and clear PAL and NTSC services are not accessible through the present generation of digital receivers.

Compatibility between MPEG2 receivers is a hot issue. Not all receivers that are DVB compliant are compatible with each other due to a small number of variations that have been engineered within the DVB standard.

Some DVB compliant MPEG2 satellite receivers are also complete multimedia terminals, providing e-mail and Internet access to the information superhighway by connection of a computer keyboard and printer.

STAR TV has developed its own compressed digital video system to launch fifty new region- and country-specific TV services on AsiaSat 2. Called DigiSTAR, the new system will use the MPEG-2

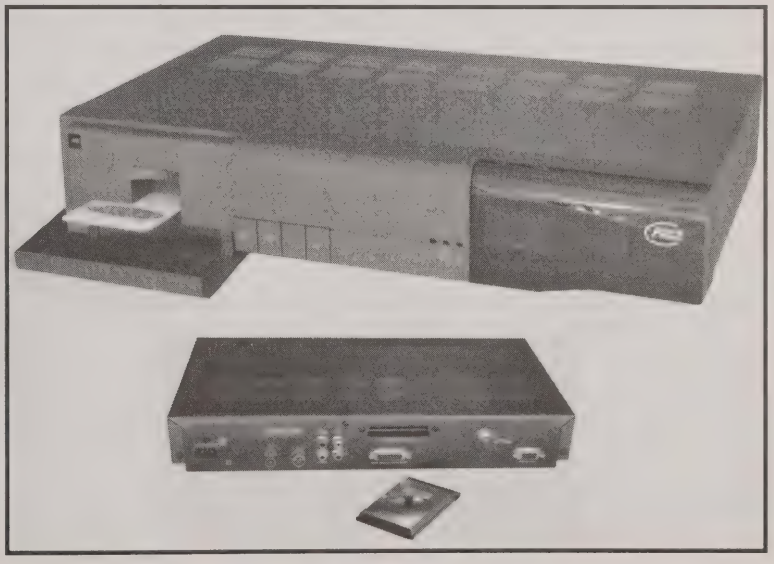


FIG. 8-10. THE PACE LEVEL 1 MPEG2 NEAR DVB COMPLIANT RECEIVER USED BY GALAXY TV. BOTH A VALID SUBSCRIBER CARD AND AN IRDETO CONDITIONAL ACCESS MODULE ARE REQUIRED FOR RECEPTION OF GALAXY'S PAY TV CHANNELS.

digital compression standard. Like Videocrypt, DigiSTAR will use a Smartcard, incorporating News Datacom's STARcrypt encryption technology. Each receiver will have addressable conditional access, allowing "pay-per-view" and the selective reception of regional programs, and the reception of data and software transmissions. As well as being able to choose in which language viewers want subtitles or dubbing, they will be able to select from a multi-screen collage of all the channels being broadcast at any time.

Several American companies have developed compressed digital video systems on behalf of American satellite programmers. Compression Labs, Inc. of San Jose, California has developed a system which can squeeze as many as eight TV channels onto a single satellite transponder with encryption.

Scientific Atlanta has developed a proprietary MPEG2 system that provides broadcasters with better control of motion artifacts occasionally visible in fast moving digitally compressed TV pictures, by allowing technicians to adjust the ratios of compression and redundancy. Named PowerVu, it is most likely to be applied to broadcast links and cable feeds where premium picture quality really counts. Users in Australia and New Zealand include BBC World on PanAmSat2 (NTSC), and Australia's ABC who use PowerVu on their Optus interchange.

DigiCipher is the name of a digital video compression system developed by General Instruments of San Diego, California which combines encryption, compression, and high definition television (HDTV) elements into a single transmission system. Much of the hardware and software development, the compression algorithms, and other elements of GI's DigiCipher system are part of an HDTV system that will be introduced in the United States beginning in 1996.

HIGH DEFINITION TELEVISION (HDTV)

HDTV—the first major advance in television picture technology since color was introduced more than 40 years ago—is to traditional television what the compact disc is to the L.P. record. The new system will transmit TV images in a frame containing more than 1,000 display lines— more than twice the number of lines used in conventional TV. The additional lines produce finer-grained pictures, having a sharpness comparable to that of 35 mm film. Both the color and brightness of HDTV are far superior to anything TV now delivers. HDTV also features a wider aspect ratio, resulting in a screen that can be viewed from a wider angle without losing the picture's impact. The screen's presence is also less noticeable, and the images appear to have depth.

HDTV IN JAPAN

Japan's NHK broadcasting company initiated the first HDTV broadcast via satellite way back in 1978. These primordial HDTV broadcasts required satellite capacity roughly equivalent to three Asiasat transponders just to broadcast one TV signal. By the early 1980s, however, NHK had developed *MUSE*, a more spectrum-efficient HDTV system that can compress the video information so that a single satellite transponder can carry the signal. In November of 1991, NHK began using a Japanese DBS satellite to transmit up to eight hours a day of HDTV programming.

WSTV 9

SATELLITE AUDIO SERVICES

The improvements in signal quality achieved by today's communications satellites are not restricted to video alone. Many home satellite TV enthusiasts are now enjoying brilliant satellite TV on large screens while surrounded by stereo sound. When listening in stereo, you become engulfed in the scene; one of the fans at mid-field, in the front row seat of a music concert, on the street, in the jungle, or anywhere a movie may take you.

Many of the scrambled services take advantage of the superior audio transmission quality achieved by B-MAC and/or various encryption systems which digitally transmit the audio information. Using a form of digital pulse-code-modulation that is similar to that employed by compact disc players, the B-MAC encryption system can deliver unparalleled audio performance directly to your home entertainment system. No special tuning is required by the operator.

Some unscrambled services also are transmitted using Wegener's PANDA stereo format. Moreover, there are dozens of audio-only services which you can also receive with your dish. These auxiliary services are carried piggyback by many of the video transponders. These stereo and monaural audio services use different frequency side channels called "subcarriers". Several subcarriers can be included in the "baseband" satellite signal along with the brightness and

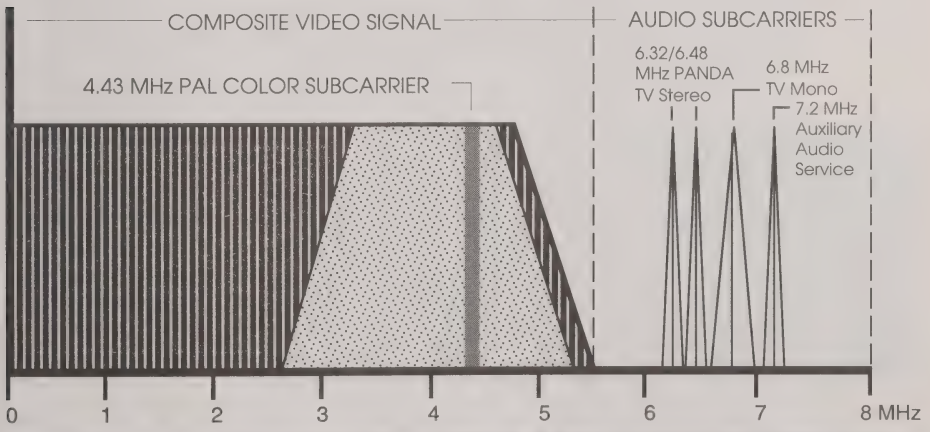


FIG.9-1. TYPICAL PAL BASEBAND SATELLITE SIGNAL SHOWING THE TV MONO AND STEREO AUDIO CHANNELS AND AN AUXILIARY AUDIO SERVICE.

color information. Their presence does not interfere with the video signal. To receive an auxiliary subcarrier service, you must adjust the receiver's audio subcarrier control to the correct frequency (or frequencies for stereo transmissions) used by audio services.

While most of the monaural sound channels for the available satellite TV services are carried in a wideband format (400 kHz), some are transmitted in a narrow band format (either 230 or 125 kHz). Adjust the narrowband audio filter setting on your receiver or IRD for clearest reception of each TV service and store the setting in the memory circuit of the receiver or IRD. Some receivers and IRDs also provide for the adjustment of the audio deemphasis for each TV sound subcarrier. Available settings include 50, 75, and 125 μs as well as the European J17 format. Select the deemphasis setting on your receiver or IRD for clearest reception of the associated sound subcarrier for each TV service and store the setting in the receiver's or IRD's memory.

For those satellite TV services which transmit in stereo, two separate subcarriers are used to carry the left and right sound channels. This audio format also is known as "discrete" stereo. To receive discrete stereo transmissions, the operator must adjust the receiver's left and right audio subcarrier controls to the correct frequencies for each TV service transmitting in stereo and store the settings in the memory of the receiver or IRD.

PULSE CODE MODULATION

Various Japanese FSS and DBS satellite services transmit the sound portion of the TV programming—as well as various auxiliary audio services—through the use of "Type A" and "Type B" pulse code modulated (PCM) audio subcarriers (5.72727 MHz). Depending on the bit rate used, satellite-delivered PCM audio can achieve a theoretical dynamic range of 80~98 dB S/N, with 98 dB comparable to today's compact disc players.

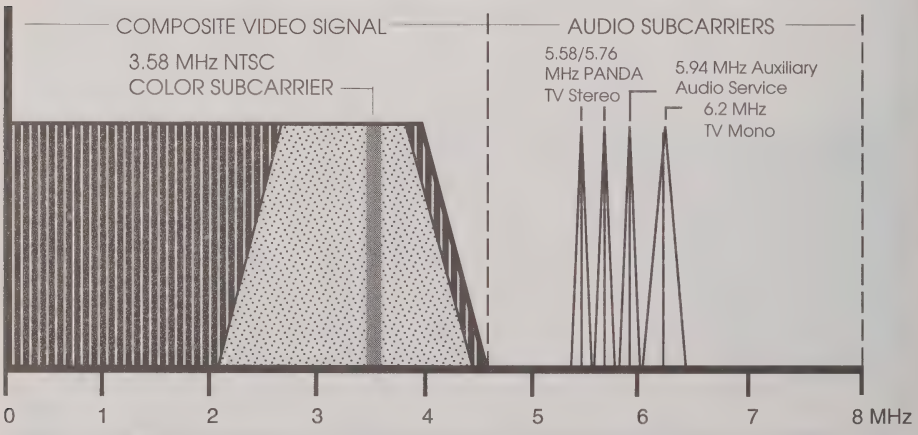


FIG.9-2. TYPICAL NTSC BASEBAND SATELLITE SIGNAL SHOWING THE TV MONO AND STEREO AUDIO CHANNELS AND ONE AUXILIARY AUDIO SERVICE.

N3	3800 MHz	Prime Sports	5.58 MHz	Mandarin Chinese PANDA I stereo (left)
			5.76 MHz	Mandarin Chinese PANDA I stereo (right)
			5.94 MHz	English PANDA 1 monaural
			6.20 MHz	Mandarin dialect wideband monaural
N4	3840 MHz	Channel (V):	5.58 MHz	English PANDA I stereo (left)
			5.76 MHz	English PANDA I stereo (right)
			5.94 MHz	BBC WSR PANDA I monaural
			6.20 MHz	English wideband monaural (English)
			6.48 MHz	STAR Radio PANDA I stereo (left)
			6.56 MHz	STAR Radio PANDA I stereo (right)
N5	3880 MHz	STAR Movies:	5.58 MHz	English PANDA I stereo (left)
			5.76 MHz	English PANDA I stereo (right)
			6.20 MHz	English wideband monaural†
N6	3920 MHz	Chinese Channel	5.58 MHz	Mandarin Chinese PANDA I stereo (left)
			5.76 MHz	Mandarin Chinese PANDA I stereo (right)
			5.94 MHz	BBC WSR PANDA I monaural (various lang.)
			6.20 MHz	Mandarin Chinese wideband monaural
			6.48 MHz	STAR Radio PANDA I monaural
N7	3960 MHz	STAR Plus	5.58 MHz	English PANDA I stereo (left)
			5.76 MHz	English PANDA I stereo (right)
			5.94 MHz	BBC WSR PANDA I monaural (various lang.)
			6.20 MHz	English wideband monaural

FIG. 9-3. STAR TV AUDIO SUBCARRIER PLAN (ASIASAT 1, NORTHERN BEAM)

S4	3860 MHz	Prime Sports	6.30 MHz	English PANDA I stereo (left)
			6.48 MHz	English PANDA I stereo (right)
			6.80 MHz	English wideband monaural
S5	3900 MHz	Channel (V):	6.30 MHz	English PANDA I stereo (left)
			6.48 MHz	English PANDA I stereo (right)
			6.80 MHz	English wideband monaural
			7.20 MHz	BBC WSR PANDA I monaural
			7.38 MHz	STAR Radio PANDA I stereo (left)
			7.56 MHz	STAR Radio PANDA I stereo (right)
S6	3940 MHz	BBC Asia:	6.30 MHz	English PANDA I stereo (left)
			6.48 MHz	English PANDA I stereo (right)
			6.80 MHz	English wideband monaural
			7.20 MHz	English PANDA I monaural
S7	3980 Mhz	Zee TV	6.30 MHz	Hindi/English PANDA I stereo (left)
			6.48 MHz	Hindi/English PANDA I stereo (right)
			6.80 MHz	Hindi/English wideband monaural
			7.20 MHz	Alternative language PANDA I monaural
			7.38 MHz	Alternative language PANDA I monaural
S8	4020 MHz	STAR Plus	6.30 MHz	English PANDA I stereo (left)
			6.48 MHz	English PANDA I stereo (right)
			6.80 MHz	English wideband monaural
			7.20 MHz	BBC WSR PANDA I monaural (various lang.)
S9	4060 MHz	Hindi Movies	6.30 MHz	Hindi PANDA I stereo (left)
			6.48 MHz	Hindi PANDA I stereo (right)
			6.80 MHz	Hindi wideband monaural
			7.20 MHz	BBC WSR PANDA I monaural (various lang.)
S12	4180 MHz	STAR Movies	6.30 MHz	English PANDA I stereo (left)
			6.48 MHz	English PANDA I stereo (right)
			6.80 MHz	English wideband monaural

FIG. 9-4. STAR TV AUDIO SUBCARRIER PLAN (ASIASAT 1, SOUTHERN BEAM)

TR.#	BEAM	AUDIO SUBCARRIER SERVICE	FREQ.	MODE
4H (7)	NB	BBC World Service Radio (1)	5.94 MHz	PANDA I Mono
		STAR Radio	6.38 MHz	PANDA I stereo (left)
		STAR Radio	6.56 MHz	PANDA I stereo (right)
6H (11)	NB	BBC World Service Radio (3)	5.94 MHz	PANDA I Mono
		STAR Radio	6.48 MHz	PANDA I Mono
7H (13)	NB	BBC World Service Radio (2)	5.94 MHz	PANDA I Mono
9H (17)	NB	Chinese Provincial Radio	7.5 MHz	Monaural
5V (10)	SB	BBC World Service Radio (1)	7.20 MHz	PANDA I Mono
		STAR Radio	7.38 MHz	PANDA I stereo (left)
		STAR Radio	7.56 MHz	PANDA I stereo (right)
8V (16)	SB	BBC World Service Radio (2)	7.20 MHz	PANDA I Mono
9V (18)	SB	BBC World Service Radio (3)	7.20 MHz	PANDA I Mono

(1) English-language service
(2) Burmese, Bengali, Hindi, Urdu, Pashto, Arabic, Turkish, Mandarin, Indonesian, Vietnamese, Thai, Tamil, Russian, and English
(3) Mandarin, Cantonese, Burmese, Persian, Vietnamese, Urdu, Pashto, & English

FIG.9-5. ASIASAT 1 AUXILIARY AUDIO SUBCARRIER SERVICES.

SATELLITE RADIO SERVICES

AsiaSat 1's STAR TV And STAR Radio services use a particular form of discrete stereo known as the *Panda I® Sound System.* Be sure your receiver has been set to receive both the left and right Panda stereo subcarrier pairs (see charts on the previous page) if you intend to receive these STAR TV and STAR Radio services in stereo. Auxiliary audio services which also are available to home dish owners, radio stations, hotels and cable operators within the region include radio networks from China, Russia, Voice of America and the BBC World Service Radio (WSR).

SATELLITE	ORBIT	TR. FREQ.	SERVICE/DESCRIPTION	SUBCARRIER
INTELSAT 511	180° E	3.975 GHz	Voice of America - English/Spanish	7.0 MHz
			Voice of America - French/Spanish	7.2 MHz
			Voice of America - Vietnam/Tibetan	7.35 MHz
			Voice of America - Lao/Korean	7.45 MHz
			Voice of America - Chinese	7.53 MHz
			Voice of America - English	7.6 MHz
STAT. 16	145° E	3.875 GHz	Radio Russia - Russian	7.0 MHz
Chinasat 5	115° E	3.760 GHz	Zhejiang Radio - Chinese	8.0 MHz
		3.843 GHz	Xizang Radio - Chinese	7.1 MHz
			Xizang Radio - Tibetan	7.6 MHz
		3.960 GHz	Sichuan Radio - Chinese	7.5 MHz
Palapa B2P	113° E	3.880 GHz	Radio Australia - English	7.2 MHz
			Voice of America - English	7.8 MHz
		4.180 GHz	STAR Radio - English	7.38 MHz PANDA I (L)
			STAR Radio - English	7.56 MHz PANDA I (R)
STAT. 14	96° E	3.675 GHz	Radio Mayak - Russian	7.5 MHz
STAT. 6	90° E	3.675 GHz	Radio Russia - Russian	7.5 MHz
		3.875 GHz	Radio Mayak - Russian	7.0 MHz

FIG.9-6. AUXILIARY AUDIO SUBCARRIER SERVICES ON OTHER SATELLITES SERVING THE ASIA/PACIFIC REGION.

SATELLITE TV DISTRIBUTION SYSTEMS

A home satellite TV system can be expanded to include satellite reception on all the TVs in your home, and possibly in your neighbor's house or apartment as well. You may want news or sports while the kids want their Channel [V]. You also may live in a caravan park or condominium where, due to space limitations, sharing a satellite receiving system is a practical solution. This chapter presents the various options available for distributing satellite signals around your home and takes a brief look at commercial distribution systems for multiple residences.

HOOKING UP SEVERAL TVS AT HOME

Most homes have several TVs on which satellite programming could be viewed. The simplest and most inexpensive way to accomplish this is to distribute the signal from your satellite receiver to the other TVs; then they can view whatever transponder is selected on the receiver. This can be accomplished through the addition of a signal splitter.

Splitters come in different configurations: two-way, three-way, four-way, etc. A coaxial jumper—a short length of RG-59 cable—connects the RF output of the receiver to the input port of the splitter.

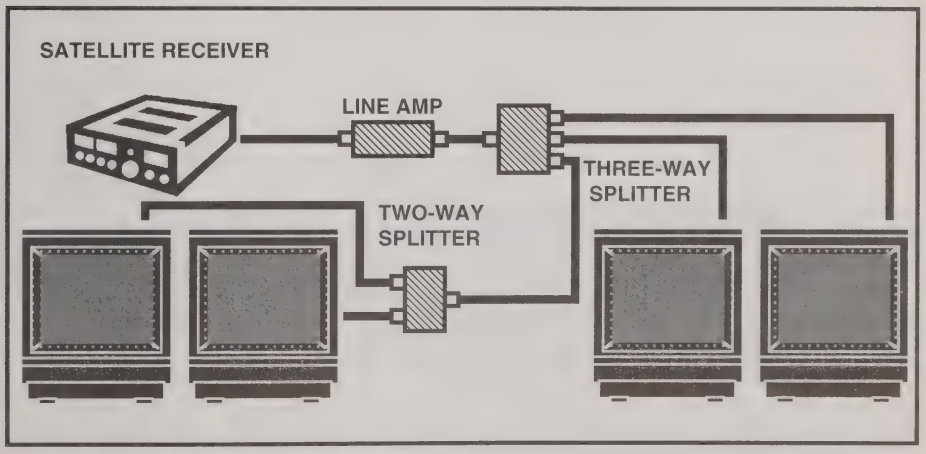


FIG. 10-1. IN HOUSE MULTIPLE TELEVISION WIRING DIAGRAM.

One output port of the splitter supplies the signal to the first TV; the other port or ports can feed the signal into the bedroom or other secondary locations. Extra splitters can be added anywhere down the line for additional TVs.

Whenever the TV signal is split and connected to several TV sets, it's strength will be considerably reduced. Although your receiver should be capable of running several TVs, larger systems with long runs of cable may require additional amplification to maintain a minimum signal level throughout the system. Inexpensive line amplifiers can be added to boost the signal if some TVs exhibit a noisy picture.

Homes with more than one TV often have one master off-air antenna that is connected to all the TV sets. The cable from the antenna often is split in the ceiling to run to all the different TV sets in the home. A "combiner" appropriate to mix the channels in use can be inserted into this cable prior to the signal splitter which feeds the various TVs. A length of coaxial cable connects the output channel from the satellite receiver's RF modulator to the combiner. From here the satellite signal is distributed—along with the available off-air channels—to all the TVs in the system. What has been selected on the satellite receiver can now be watched by tuning to the TV channel corresponding to the output of your receiver's RF modulator on any TV connected to the system.

An alternative method is to use a low cost low power TV video sender to transmit TV programming from the living room to the bedroom, without having to drill holes or string wires. The signals can pass through lighter built walls and floors as far as 200 feet. This device is connected to the video and audio outputs of the satellite receiver and placed on top of the TV set or in some other high unobstructed location.

Some models transmit UHF frequencies which can be received by the UHF tuner on your TV set. Others use a special remote TV receiver which connects to the antenna input of any TV set. This remote receiver can pick up the special frequencies which have been set aside expressly for home video applications. Additional receivers can be ordered so that multiple TV sets throughout the home can simultaneously receive any program.

Your next door neighbors also could purchase one or more of these special receivers and they too could watch what you are watching. Many people would

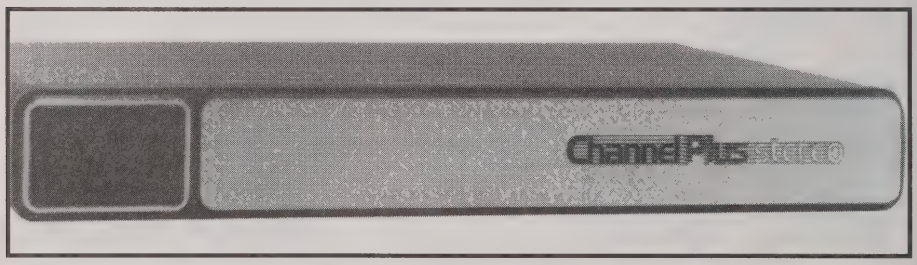


FIG. 10-2. THE CHANNEL PLUS A3V CAN BE USED FOR DISTRIBUTION ON UHF VIA CABLE. THIS DEVICE CONVERTS VIDEO AND AUDIO SIGNALS FROM A VCR, SATELLITE RECEIVER, AND ONE OTHER SOURCE TO UNUSED UHF CHANNELS.

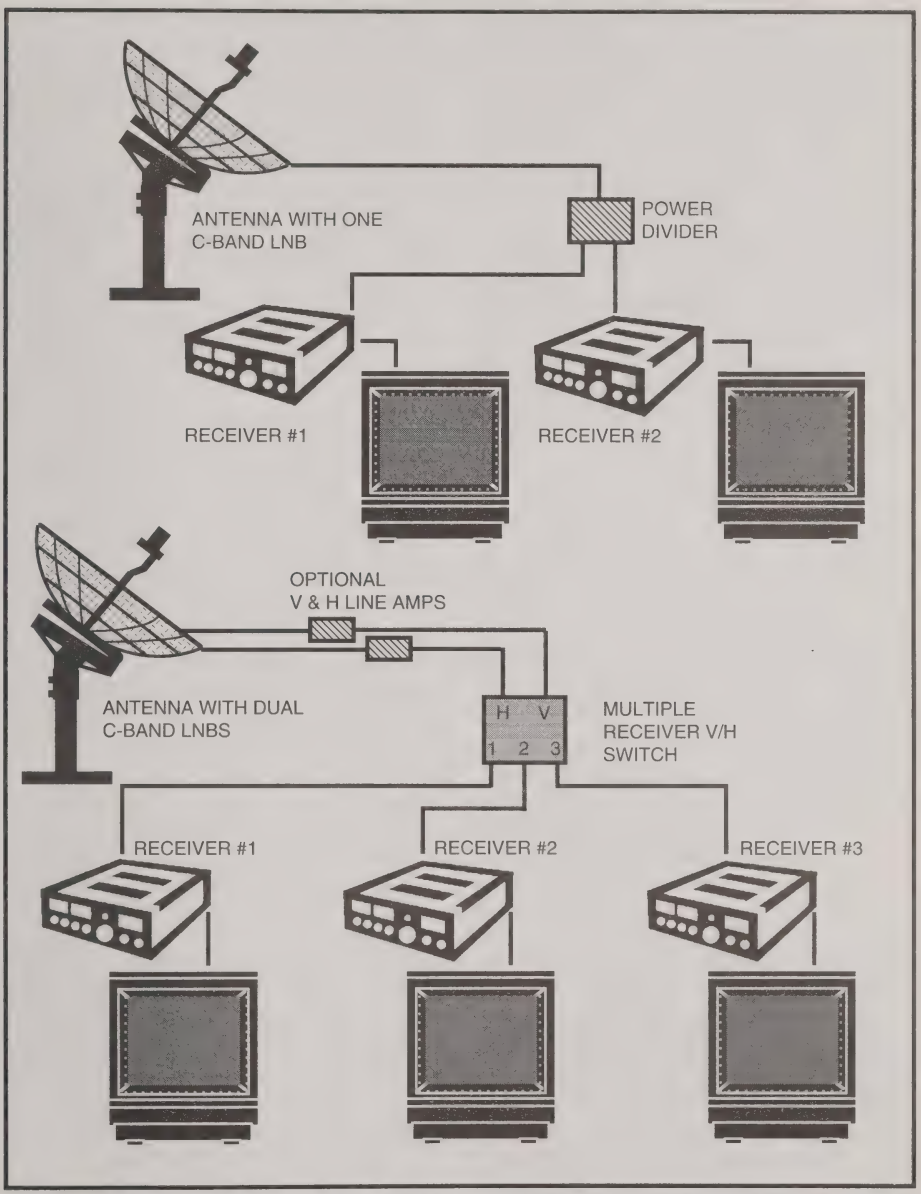


FIG. 10-3. SINGLE POLARIZATION, TWO RECEIVER; AND DUAL POLARIZATION, MULTIPLE RECEIVER BLOCK SYSTEMS.

find such an arrangement too limiting. Reaching agreement about what to view may be all but impossible in your own home, without letting your neighbor have a say as well. Therefore, you might want to consider other systems which can provide independent access to different satellite TV channels.

MULTIPLE RECEIVER SYSTEMS

The next level of independence requires two or more receivers, each choosing among the available satellite TV channels of one polarization. To accomplish this, the signal coming from the LNB must be divided, so that each receiver can operate independently of the others.

With a block downconversion system, each satellite receiver can independently choose from among available channels of the same polarization format. This setup is perfect for dedicated reception of Asiasat 1's STAR TV services, since all five TV channels for your region are carried on a single polarization.

Reception of all available TV services on Palapa B2P, however, would require simultaneous reception of both polarization formats. Otherwise, if you change the polarization of the LNB, you change the channels available on all receivers in the system. To receive both polarizations at once, it will be necessary to install a dual polarization orthomode feedhorn and two LNBs. With a dual polarization system, each receiver can be independently tuned to any of the available channels carried aboard Palapa B2P or any other available satellite.

One coaxial cable from each LNB is required. Depending on the specifications of the system, other accessories—including V/H polarization switches, line amplifiers, and power blocks—may be needed. A polarization switching voltage supplied by each receiver determines which of the two LNB output signals is to be routed by the V/H switch to the input of its associated receiver.

Some satellite receivers have built-in Vertical and Horizontal switches with separate input connections for each LNB. However, if you are adding a Ku-band LNB to the dual LNB C-band system, an external H/V switch will be required. Whenever the IRD is used for dual band reception, the H/V switch becomes a C/Ku-band switch.

MINI-CABLE SYSTEMS

While all the systems we have discussed so far would be more or less adequate for serving the needs of a few residences or even a small apartment building, cost-effective coverage of larger multiple dwellings requires the construction of a mini-cable system. In condominiums, caravan parks, and public buildings such as hotels, motels, and health care facilities, mini-cable systems can be very practical. Often these systems are installed by the owners or managers as a commercial venture. Tenant cooperatives and neighborhood associations also may become involved in the installation of these systems.

Called SMATV (for satellite master antenna), mini-cable systems select a few services off the satellites, change them to regular TV channels, and send them down a cable to the individual residences. A separate satellite receiver is tuned to each service selected. The video and audio from each receiver is connected to an external RF modulator. The output of the RF modulator corresponds to an unused or open channel in the SMATV system. Some manufactur-

ers provide commercial rack mounted receivers and modulators expressly for this purpose.

The local off-air and satellite modulator channels are combined and sent down the cable to each individual residence in the system. All signal levels are balanced to prevent the stronger ones from causing interference to the weaker ones.

When a strong local TV station is directly received off the air as well as through the SMATV system, a "ghosting" condition may result. To prevent this, local channels can be converted to a different channel on the cable. For example, local channel 2 becomes cable channel 6.

Sometimes a mini-cable system might use spare VHF or even UHF channels to carry additional satellite services. Cable ready TVs can be used to display these channels. Non-cable ready TVs require a special cable box to convert these "mid-band" channels back to ones which can be picked up by a regular TV set.

A videocassette or laser disc player can be added to a mini-cable system for the showing of in-house tapes. A TV camera on the front door or playground also can provide a video signal that could be distributed throughout the complex.

There are many technical considerations involved in the installation of an SMATV system. For example, to receive encrypted services, commercial rack-mounted descramblers or IRDs must be used at the headend. Better equipment manufacturers and distributors have service departments which will help you design the appropriate system and place the correct order for parts.

SMATV operators may find that a spherical antenna, which can view several satellites at once, is a good investment. You can mount a number of feedhorn/LNB assemblies in front of the spherical antenna, thereby giving it the flexibility to simultaneously receive multiple satellites. When a new satellite goes up, you can simply add a new

FIG.10-4. A LARGE APERTURE C-BAND ATELLITE ANTENNA WITH MULTIPLE FEEDHORNS FOR SIMULTANEOUS RECEPTION OF FIVE DIFFERENT SATELLITES.

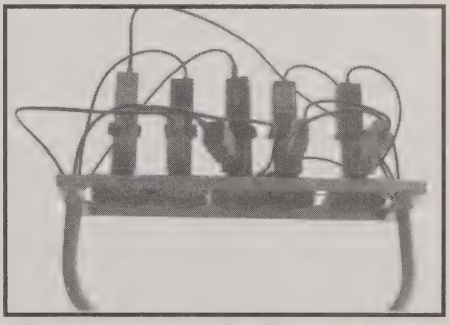


FIG. 10-5. CLOSE-UP VIEW OF THE FEEDHORN PLATFORM.

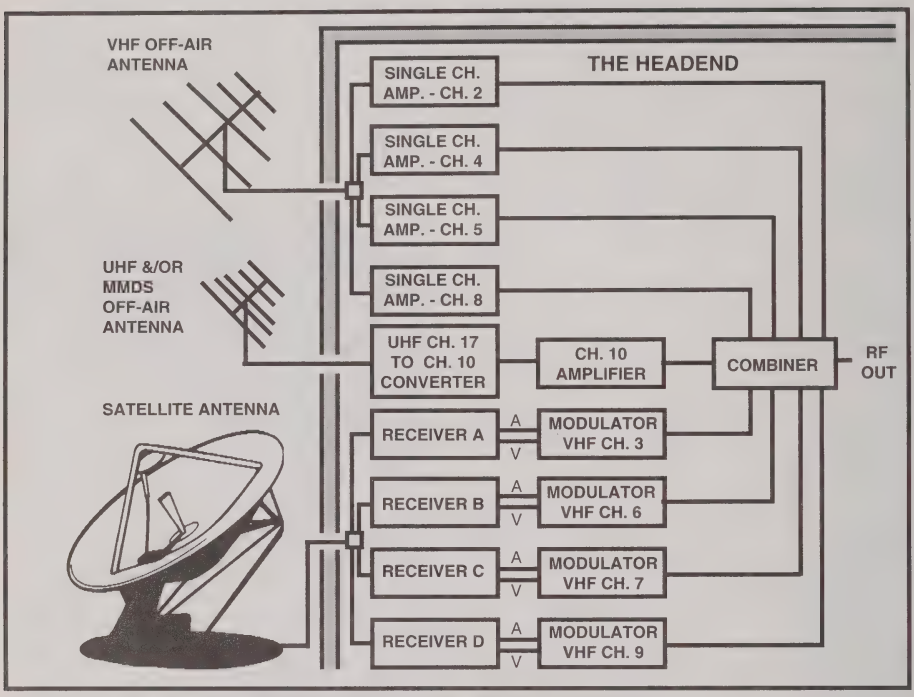


FIG. 10-6. A TYPICAL HEADEND PROVIDING SATELLITE, VHF, AND UHF TV CHANNELS.

feedhorn/LNB assembly for that bird. Likewise, if you wish to view a special program on a satellite you usually don't watch, you can just add another feedhorn/LNB assembly; since you do not have to readjust the antenna's alignment, the additional programming will be available without sacrificing reception of the satellites you normally view. Moreover, if a program originator changes satellites you too can make the change easily.

Multi-beam parabolic antennas also are available. A shallow dish provides a wide look at the Clarke Orbit. Multiple feedhorn/LNB assemblies called "cross-eyed feeds" can be mounted above the dish to allow simultaneous reception of multiple satellites. Keep in mind, however, that multiple-feed parabolic antennas will need to be larger than a dish equipped with a single feed.

MULTICHANNEL MULTIPOINT DISTRIBUTION SYSTEMS (MMDS)

In Australia, Thailand, and elsewhere within the Asia/Pacific Region, Multichannel Multipoint Distribution Systems (MMDS) recently have been introduced for the delivery of pay TV services to subscribing households. MMDS commonly is referred to as "wireless cable," because of the technology's ability to

deliver a significant number of television programming channels to any customer's home within a given local area, but without the use of a cable. Instead, the MMDS channels are sent "over the air" and can be viewed by any subscribers equipped with a corresponding receiving antenna and frequency converter.

WIRELESS CABLE

There are many similarities between traditional cable TV distribution and MMDS systems. Both technologies receive their program packages via satellite. The programming is then reconfigured at the satellite receiving "headend" and then relayed as a package to local subscribers. Both systems also can be designed to offer individually-priced sub-packages of programming, called "tiers," to their subscribers, or even provide Pay Per View movies and special events which can be ordered on demand. Both delivery systems require that a technician come to each subscriber's home to install the basic receiving equipment. The major difference between cable and MMDS lies in just how these services are delivered to the customer's home.

MMDS VERSUS CABLE TV DISTRIBUTION

Large cable TV systems require a significant investment of time and money on the ground to build a wired grid that passes each and every home within any local coverage area. MMDS transmits a signal directly over the air, with good line-of-sight coverage for between ten and thirty miles, depending on terrain. Since an MMDS service does not have to design, build and maintain a costly cable system, the overall cost of establishing a service in any given area is typically one-third to one-half the cost of a comparable cable distribution system. MMDS services also can be established more quickly than cable TV distribution systems, and can reach all of the potential subscribers within the intended coverage area right at start-up. If reliable, high-quality components are used at both the transmit and receive end, there is a substantially lower level of signal outages, which results in a higher level of customer satisfaction. Since the MMDS is less complicated than a cable delivery system there are less components which can fail and require service.

MMDS, however, does have several disadvantages compared to cable. The available number of MMDS channels in any given area is limited, which means that fewer channels of programming can be offered to subscribers. More costly equipment also is required at the customer premise. MMDS signals also are limited to the line-of-sight, which means that the MMDS operator must work to fill nulls and voids caused by terrain and/or buildings in the service's over-the-air signal coverage. Some systems may require the use of a "back feed," a repeater which sends the signal back toward the transmit tower to fill in an area blocked by hills, tall buildings or other obstructions. (To provide isolation between the original and duplicated signals, the back feed transmits using the opposite sense of polarization.)

Some of the more advanced cable TV distribution systems in America and elsewhere also now are providing their subscribers with interactive capabilities, such as home shopping. The cable acts as a two way street where information can flow in either direction. Since MMDS is a wireless service, there is no way for

data to flow from the subscriber back to the system operator short of using the telephone line.

MMDS FREQUENCY PLAN

The frequency band assigned for MMDS operations in Australia lies between 2.176 and 2.4 GHz. This frequency band comprises nineteen 7-MHz-wide channels which are divided into six channel groups (1A, 2A, 1B, 2B, 3B, & 4B). Similar frequency assignments are followed in other nearby countries.

Like the higher frequency satellite signals previously described, MMDS transmissions are microwave signals which exhibit many of the characteristics of visible light. Microwaves travel along the line of sight and therefore can be blocked by hills and other rough terrain or by buildings or other man-made obstacles. It therefore is essential that both the transmit antenna and any associated receive antennas be positioned so that they have a clear view of each other.

THE TRANSMIT SITE

The MMDS operator must construct a delivery system which can deliver enough signal to each subscriber's home so that a good picture—one that the customer will be glad to pay for—is received. The MMDS system operator will construct a headend system similar in many respects to the headend previously illustrated on page 132. The video and audio output of each satellite TV receiver, VCR, or other program source feeds into a Radio Frequency (RF) channel modulator. The RF output of each modulator is then upconverted to microwave frequencies and greatly amplified by an MMDS transmitter (also called an amplifier by some manufacturers), which outputs a signal that typically ranges from 10 to 100 watts, depending on the local terrain and the size of the area to be served. The outputs of these transmitters first goes into a signal combiner, which connects to the transmit antenna via a transmission line. The transmitting antenna site must be located at a high, unobstructed location to overcome any obstructions to the signal, such as rough terrain or tall buildings. As the power requirements of the MMDS system increase so does the associated cost of the transmitters, the combiner, the transmission line, and the transmit antenna.

THE RECEIVE SIDE

From the transmit site, the MMDS signal radiates through the air to reach all locations within the primary coverage area of the system. At each subscriber's home, a relatively small and inexpensive receiving antenna picks up the signal. For adequate reception of the microwave signals, the receiving antenna must have a clear line-of-sight view of the transmit antenna. Unlike lower frequency radio waves, which can penetrate the walls of a building or nearby foliage, the microwaves used for MMDS transmission are limited by any obstructions between the transmitter and receiver. For this reason the antenna typically is located on a tall mast anchored to the house.

A small, medium, or large antenna is selected for each subscriber's home, with the size selected depending on the distance from the transmit site— the longer the distance the greater the antenna size required to receive a good picture. An omnidirectional antenna typically is used at more centrally located homes, while a directional antenna is more often used at locations towards the edge of the

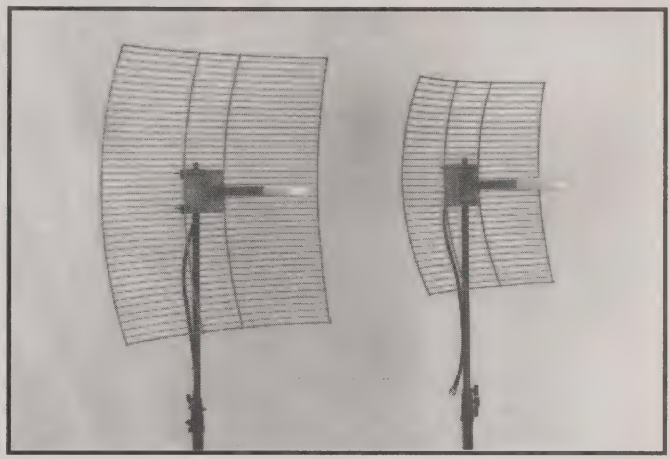


FIG. 10-7. MMDS QLP PARABOLIC ANTENNAS. (COURTESY CALIFORNIA AMPLIFIER.)

desired coverage area.

After arriving at the antenna, the MMDS signal is shifted or "downconverted" to a lower band of frequencies (either VHF, UHF or Mid-band) which are compatible with the TV set's channel tuner. To minimize signal loss, a weatherproof downconverter often is mounted directly behind the receiving antenna. The output of the downconverter is then routed into the home via coaxial cable. This cable may either connect to the antenna input of the TV set or set top converter.

A set top converter is required whenever the MMDS transmits encrypted program services, or whenever there aren't enough available VHF or UHF TV channels to handle all of the MMDS program services. If the downconverter converts some of the channels to Mid-band fre-

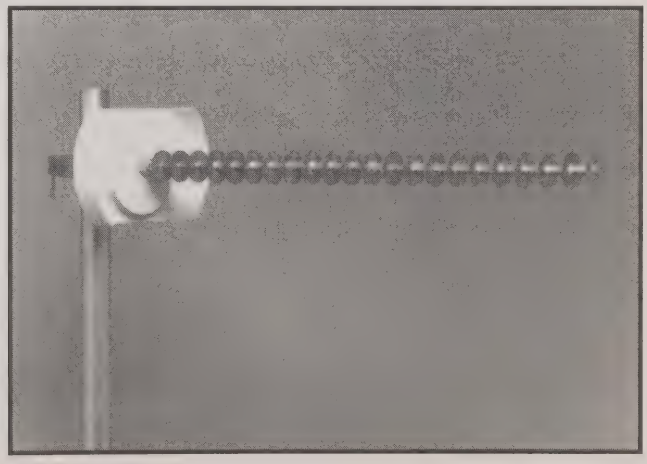


FIG. 10-8. MMDS DOWNCONVERTER WITH INTEGRATED YAGI ANTENNA. (COURTESY CALIFORNIA AMPLIFIER.)

quencies, cable ready TV sets will be able to receive all of the unencrypted channels without aid of a set-top converter.

SIGNAL SECURITY

There is a certain level of security built into any MMDS system because of the special equipment required to receive the microwave signals and convert them to channels which are viewable on any standard TV set. This level of security can further be enhanced by encoding some or all of the channels. The degree of encoding can range from simple sync suppression or video inversion to more sophisticated addressable systems that are controlled by computers. Addressable systems control what can be viewed by each subscriber's converter, thus providing a means by which the system operator can offer both basic and premium programming packages, PPV events, and the ability to disable the converters of customers who fail to pay their monthly subscription fees.

It should be noted, however, that addressable converters cost two to three times what standard, non-addressable converters cost, so operators must weigh the additional benefits of enhanced security and the ability to deliver multiple tiers or pay per view against the additional investment per subscriber required. Addressable systems also use an expensive computer and computer software, as well as a special encoder which must be installed at the headend for each MMDS channel to be delivered.

LOW POWER MMDS SYSTEMS

Low power, one-watt broadband MMDS amplifiers recently have become available which combine the output of up to eight channel modulators and then upconvert and amplify the whole range of frequencies together. There is a significant cost saving to this design over using eight separate amplifiers and a high frequency combiner. Because of the lower costs involved, low power MMDS distribution systems can be used to provide services to smaller communities which may not have a large enough subscriber base to warrant the installation of a higher power system.

This new design approach also avoids the signal loss normally associated with high frequency combining after the amplifiers. A one-watt per channel system can therefore be engineered to achieve nearly the same signal level as an eight channel conventional system using ten-watt amplifiers. Additionally, higher power levels per channel in the broadband amplifier can be achieved when fewer channels are combined. For example, the same one-watt, eight channel system will deliver two-watts per channel when six channels are combined.

INTERFERENCE PROBLEMS

The most common sources of strong interference to MMDS signals are caused by airport and weather radar systems which use S-band frequency spectrums which are adjacent to the frequency band used for MMDS signal delivery. MMDS interference problems are often solved through the use of a very sharp preselector filter that reduces the level of the interfering signal before it reaches the receiving system's preamp. Some MMDS downconverters come with a built-in preselector filter. These filters also are available separately and can be added to any downconverter.

WSTV 11

TROUBLESHOOTING

If your system goes on the blink, there are a few things you can check, perhaps even fix yourself. Many dish owners who live in rural areas can't just call to someone nearby for help; so it's good to know some basic troubleshooting techniques.

When working on any kind of electrical equipment, you must remember, Safety First! Almost all satellite TV receivers and IRDs run on 240 volts a.c., enough to kill a person. The lower d.c. voltages that run on the cable that connects your receiver to the LNB and actuator, while not enough to do any bodily harm, can cause irreversible damage to expensive electronic circuitry if improperly wired.

There are certain safety precautions that should be taken before removing the cover off a satellite receiver or IRD.

» Never take the cover off with the power cord plugged in.

» Move any metal objects or wires well away from the receiver when testing or working on it; this helps prevent an accidental short circuit.

» Never turn on a receiver or IRD unless a fuse of the correct amperage is in the fuse holder.

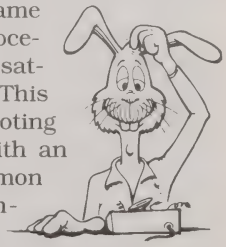
» Do not touch any components inside the unit while the power is connected.

» Water is a good conductor of electricity; do not work on a receiver or antenna actuator if you are wet or if you are standing in a puddle.

» Do not work on your set while there is a lightning storm in progress.

If you are going to get inside the satellite receiver, be sure you know the proper procedure. Aimlessly twiddling the various tuning pots and capacitors in your receiver might look inviting, but without proper test equipment self inspection of the satellite receiver could turn your entertainment center into an expensive junk sculpture. You also may void the warranty.

Now, having given you a proper warning, it is only fair to point out that many times the problems which occur are quite simple and can be taken care of easily. Although some systems offer slightly different features they are all comprised of similar basic components. It therefore stands to reason that you would follow the same troubleshooting procedures for any home satellite TV system. This guide to troubleshooting will provide you with an overview of the common problems encountered, how to iden-



tify them, and their solutions.

Before getting very far into troubleshooting, you will need to understand how to use a multimeter or volt ohm meter—a basic electrical tool that can be used to measure voltages and to check for shorted connections or breaks in the wiring. When checking your system, it would also be handy to have access to a spare LNB. You may reach a point where the LNB could become the main suspect.

While all systems work in a similar fashion, there may be idiosyncrasies with your particular model of receiver or antenna positioner. Manufacturers have service departments which will be glad to help you and are most likely to be familiar with the problem you are experiencing.

INSTALLATION TIPS

Make sure that your TV set has been fine tuned to the channel output of the receiver's RF modulator. Some TV sets may have to be programmed to receive the satellite receiver's RF modulator channel. You would be surprised how often this is overlooked. You can by-pass the receiver's RF modulator by connecting the video and audio outputs through a VCR or directly to a TV monitor. If you receive a picture from the receiver's video output but not from the RF output, the problem could be a bad modulator.

A long length of cable between the receiver and antenna may markedly reduce the signal level to the receiver. In-line amplifiers are available to increase the signal strength. Many satellite receivers have IF gain control adjustments which are turned down at the factory to keep the LNB from overdriving the receiver whenever a short cable run is used. High signal levels will cause noise to appear in the picture. This noise looks just like the sparklies seen while receiving a weak satellite signal. A low signal level also can inhibit any descrambler from decoding a scrambled channel.

The trick is to find the receiver's IF gain control. Sometimes this control is on the back, the bottom, or on the side of the satellite receiver. It may even be located inside the unit. Check your instruction manual. If there is no mention of an IF gain control in the manual, ask the manufacturer if one is provided. The gain control should be adjusted so that the strongest channels almost peak your signal strength indicator.

PROBLEMS ASSOCIATED WITH THE ELECTRONICS

If one day your system stops receiving a picture—or only receives a noisy picture with very little signal registering on the meter—either bad weather has shifted the antenna's alignment or some part in the system has failed. Check the antenna to see if the marks you made on the pole and the mount during the installation process are still lined up. If your picture fades in and out on windy days, tighten any loose bolts on the mount and actuator arm to eliminate any sloppiness or "play".

Check the antenna's alignment by having someone push up or down, or left and right, on the rim of the antenna while you look at the meter reading of the satellite receiver. If the meter level goes up when someone pushes on the dish, then the antenna is no longer properly aligned.

Move the antenna until it reaches its highest elevation angle. If you push up on the antenna and the signal level goes

up, the antenna's mount should be rotated slightly counterclockwise. If you push down on the antenna and the signal level goes up, the antenna's mount should be rotated slightly clockwise.

Be sure to make your adjustments in tiny increments and recheck the alignment by using the above mentioned procedure once again. If you continue to have an alignment problem refer back to the alignment section of the installation chapter for further assistance.

If there are no problems with the antenna or mount, you can assume that something is wrong with the system electronics. You will need to isolate the problem down to the individual component that is responsible. Start at the receiver and work your way out to the LNB, checking any in-line amplifiers or other components along the way. Temporarily take any splitters or switches out of the system and connect the LNB directly to the receiver. If the system works after this, one of the disconnected components must be bad.

Most receivers deliver 18 volts d.c. up the coax to the LNB—even when the equipment is turned off. This helps prevent moisture from condensing inside the LNB housings and enhances LNB stability by minimizing any temperature variations. Unplug the satellite receiver from its wall receptacle before connecting or disconnecting the IF cable. This will protect the electronics from possible damage in the event that you accidentally short out the connections.

Check to see if there is 18 volts d.c. coming out of the back of the receiver. The LNB can't function without power. There is a fuse or circuit breaker inside the receiver which protects this circuit. A short in the line does not ordinarily blow the receiver's main fuse or circuit breaker.

Unplug the receiver from the wall receptacle, and then locate and replace the blown fuse. Before you reconnect the IF cable, turn the receiver back on and see if the fuse blows once again. If it does, there is a problem in the receiver's power supply and the unit will have to be sent back to the manufacturer for repair.

Most of the problems you run into are caused by water intrusion. Check both ends of the cable and any connectors between the LNB to see if any piece of braid is touching the center conductor or if water in the connectors is causing a short. Any moisture here also can make your picture look jumbled, very weak, or even blank. This can be prevented by using a waterproofing compound around the connector or flooding the connector with a dielectric sealant.

When checking cable for continuity, first unplug the satellite receiver, disconnect the cable from the LNB, then reconnect the cable and plug the receiver back in. If the fuse blows, there is a short in the cable. If the new fuse doesn't blow, check to see if you have 18 volts d.c. at the far end of the cable. Lack of voltage indicates a break in the cable, which will have to be replaced. Check it for continuity.

We recommend that you unplug the receiver when making or breaking these connections. If the fuse is blown by accidentally shorting the cable, an accurate test cannot be made and damage to the LNB could occur.

LNBs are very susceptible to water and to lightning damage. A lightning bolt

doesn't have to physically hit the dish to wreak havoc on your system. Nearby lightning strikes can generate a transient voltage which can fry the sensitive microwave parts of the unit. A bad amplifier stage in a LNB will be evident if you receive clear pictures on the lower channels but noisy pictures on the high end, or vice versa.

An eight-foot ground rod pounded in next to the dish provides some lightning protection for your system. Copper braid ground straps connect the dish and antenna actuator to the ground rod. Check to be sure that the ground straps are providing your system with a good electrical connection. If any corrosion of these connections is discovered, disconnect the copper ground straps, scrape them clean with a knife, and then reconnect them to the system.

Take the cover off the feedhorn and LNB assembly and check the neoprene gasket that seals the joint between the feedhorn and LNB. The LNB should be tightly bolted to the feedhorn. If the mounting bolts are loose or if the gasket was improperly seated during installation, moisture will be able to seep around the gasket and enter the feedhorn's waveguide—the metal joint that links the feedhorn to the LNB. If you do discover that moisture has gained entry into the waveguide, use a hair dryer to remove the condensation then carefully reattach the LNB to the feedhorn flange so that the gasket completely seals the joint.

If water has condensed inside your LNB, it is possible to return this component back to life by taking it inside and drying it out. Do not open the LNB as this will void its warranty. These units contain especially sensitive microwave transistors which are beyond the ability of most mortals for home repair.

If the LNB is receiving the proper voltage and there is no evidence of moisture in the connections, check to see if replacing the LNB will correct the problem. If after substitution the system still doesn't function properly, inspect the feedhorn. On rare occasions a feedhorn that won't pass the signal on to the LNB simply needs to be checked to make sure that wasps or other insects haven't built a new home in the throat of the unit.

If everything checks out and you still don't receive a good picture, try a new receiver or try the receiver on someone else's system. You could have a bad electronic stage inside the receiver.

PROBLEMS ASSOCIATED WITH ACTUATORS

The major culprit when it comes to problems with actuators is water! No matter what you do, water is going to get into the motor housing. Water accumulation can short out the connections to the actuator and blow the circuit breaker in the positioner or satellite receiver. This can easily be corrected by drying out the inside of the actuator and cleaning the connectors.

It is important to have a way for the water to escape. Make sure to follow the directions during installation which usually place the incoming wires on the top side of the motor and the drain holes on the bottom. If there aren't any drain holes, remove the actuator cover and drill a drain hole in it.

If you don't move your dish frequently from one satellite to another, the arm can corrode and become stuck. The arm should be cleaned and lubricated periodically. Fully retract the antenna's actuator arm, clean it with a solvent, then

lubricate the arm with a waterproof "marine grade" grease that can withstand continual exposure to the weather.

If the dish won't move at all, a bad connection to the actuator's motor could be the cause of the problem. After making sure the parental lockout has not been activated, check to see if 36 volts d.c. is present at the back of the satellite receiver whenever the antenna is commanded to move.

Some antenna positioners provide 24 volts d.c. to the actuator motor instead of 36 volts d.c. Providing only 24 volts will not affect the actuator motor's performance. Check the specifications in your owner's manual.

Next, check to see if this voltage is being received at the motor terminals inside the actuator housing. If it is not reaching the motor terminals you may have to replace the actuator cable. If the voltage is present at the motor terminals and the actuator still doesn't engage, there may be an open winding in the motor which will need to be replaced.

All actuators have a circuit that generates pulses and delivers them to the receiver for counting. If the dish momentarily moves and then shuts down, the receiver didn't get a pulse from the actuator's sensor. This symptom is usually accompanied by an "actuator error" readout on the TV screen or on the receiver's front panel display.

Several different kinds of sensors are used in the actuators being manufactured today. Some of these require 5 volts d.c., while others do not. Although a bad sensor is a common problem, it can easily be replaced. If your actuator is the type that uses a magnetic wheel, make sure that the sensor is close to—but not actually touching—the wheel. These magnets sometimes wear out and may need to be replaced. If you determine that these components are good and the receiver still does not get a count, check the sensor wiring for continuity.

If your particular sensor requires 5 volts, make sure that the current is reaching the motor. If your receiver stops supplying 5 volts to the actuator, it is a good idea to switch to a reed or other type of sensor which doesn't require voltage.

If the dish doesn't precisely locate a specific satellite every time, check the antenna mount for signs of any slop or play. Move the dish up or down by hand to discover which bolts may need to be tightened or what other antenna parts need to be replaced. If you need to realign the programmed locations for all satellites, it may not be necessary to reenter the location for each individual bird. Many satellite receivers provide an automatic antenna realignment feature that can be used after reprogramming the location for a single satellite. Be aware, however, that this will realign your east and west limits as well.

If the satellite receiver loses its memory, the unit's back-up battery may not be supplying power to the memory circuits during power outages. The unit's microprocessor may also be blown. Refer to the owner's manual for further information about repair or replacement.

PROBLEMS ASSOCIATED WITH POLARIZERS

If you are receiving only one polarity or are receiving two polarities at once and cannot skew the polarity to make the picture come in, there may be a problem with the servo motor on the feedhorn. The servo motor also can freeze up in winter. Moreover, servo motors

wear out and must be replaced.

The best way to check the servo motor is to bring the feed inside and hook it up directly to the back of the receiver. As you change the receiver's polarity or skew settings, the probe in the mouth of the feed should rotate in a clockwise or counterclockwise direction.

If the probe doesn't move, use a volt ohm meter to determine if the receiver is generating 5 volts d.c. whenever you adjust the polarity. If not, the problem lies in the receiver's internal power supply. A few receivers have an internal fuse which protects this part of the power supply. Consult with the receiver's manufacturer, and if their product doesn't have a separate fuse, be sure to ask for a return authorization number and send the receiver in for repair. If you can't stand the pain of being apart from your receiver, buy an external polarizer control.

If 5 volts d.c. is present at the feed and the probe still doesn't move, you will need to replace the feed's servo motor. A replacement servo is relatively inexpensive. If the probe does move when hooked directly to the receiver, check the wires going out to the dish for a break or short in the line.

Remember, when installing a feedhorn on the antenna, it must be aligned so that the probe can swing the 90 degrees from horizontal to vertical (or left-hand circular to right-hand circular) polarization without reaching its limit of travel. If you can't skew the probe beyond a good picture on odd and even channels on all satellites, the feed must be physically rotated until it is possible to do so.

Electronic ferrite feeds have no moving parts, so you won't be able to physically observe any movement during operation. Instead, use the volt ohm meter to determine whether or not the feed is receiving 18 volts d.c. You can also check the windings to see if there is continuity across them.

The additional weight of adding a Ku-band LNB to your C-band system may cause the feed to shift off center. Guy wires should be added to button hook feeds to help position them directly over the center of the dish. Once the guy wires are in place, measure from the rim of the dish to the outer ring feedhorn from several locations. The feed is centered if all these measurements are equal.

FIGHTING TERRESTRIAL INTERFERENCE

Even if your initial site survey revealed no interference, there is no guarantee that the telephone company will not start transmitting through your area sometime in the future. Microwave interference typically shows up as a problem on a few satellite channels. In some extreme cases, when the source of the terrestrial interference (TI) is strong and nearby, it can wipe out a channel or a whole block of channels on one or more satellites. Some channels may be blacked out or have sparklies that simply won't go away, while other channels will look just great.

A dead giveaway that TI is present is indicated when certain channels appear to be weaker, yet the signal strength meter registers higher than on other channels. You may have to fine tune the video away from the TI carrier frequency to receive the best picture. Try adjusting the video frequency to see if the picture improves even if the signal level goes down. On some receivers you can store the best setting into memory.

You also should suspect microwave

interference if sparklies only affect reception of certain satellites and channels; there may be a tower off in that direction. If your receiver does not have a TI filter or this setting does not seem to do enough to clear up the interference, you can use an external "notch" filter to selectively remove the portions of the receiver's IF bandwidth where TI normally will appear. This will remove the relatively narrow telephone microwave carriers from the affected transponder's 36-MHz bandwidth, while passing the majority of the satellite signal. If the notch filter alone does not fully remove the interference, there also are passband filters that can be used to further adjust the passband of the receiver.

Check the receiver's back panel to determine whether it can accept an "outboard" filter. If the receiver has a short jumper cable linking the input and output ports of its second IF, it can accept a filter.

Some receiver manufacturers also provide modification kits for receivers which didn't originally come with IF loop-through connections. The frequency of the filter you purchase must match the IF loop-through frequency scheme of the receiver (70-, 140-, 510-MHz, etc.). U.S. companies such as Microwave Filter Company offer a complete line of filters that can interface with the 2nd IF loop-through frequencies of almost any receiver.

When you encounter very strong TI which wipes out an entire channel or group of channels, filters alone will not eliminate the problem. In this case, the interference must be blocked before it reaches the LNB and receiver. It may be possible to move the dish to another location which is shielded from the TI by your house or another building. You also can build a solid metal fence or screen, positioning it between the microwave source and your antenna. Make sure the fence or screen is well grounded. In extreme cases, special microwave filters are available which are attached ahead of your LNB.

PROBLEMS WITH DECODERS

If your satellite TV system is equipped with a decoder, you should be aware that the presence of TI can prevent your unit from locking on to an encrypted channel. The use of a notch filter is the preferred way to handle this situation. Passband filters generally are ineffective for removing TI from encrypted channels because they remove so much of the incoming signal that the decoder will not lock onto the service.

Many satellite receivers and IRDs come with built-in TI filters which you can program into memory on a channel-by-channel basis. When using a TI filter, be sure to adjust the video fine tune control for the affected channel until the best reception is obtained.

If your decoder will only intermittently lock on to one or more of the encrypted channels, the frequency setting of the receiver may be slightly off center frequency. In this case, use the receiver's video fine tune control to adjust the frequency setting so that the unit will lock on to and authorize the encrypted service reliably.

If you have been on a long vacation or for some other reason your decoder loses its authorization, you can tune to any channel to which you subscribe and call the subscription service for an "instant hit". This should bring it back to life.

If the unit seems to have lost its memory

and will not display its ID number, the battery in the decoder may have worn out. The battery is there to hold the memory intact whenever the power goes out or the unit is unplugged. Designed to last for several years, the batteries eventually wear out and will need to be replaced. The module will have to be sent back to the manufacturer or its authorized service center to have a new battery installed and your authorization keys reinserted. Opening the module yourself will void the warranty.

WINTERIZING YOUR SYSTEM

While most of the countries and territories of the South Pacific are blessed with warm weather the year round, there remain areas where freezing temperatures may occur. If you live in one of these locations, make sure that you take a critical second look at the entire system each year before cold weather arrives. A few simple preventive maintenance procedures can keep your satellite system from going on the blink.

If you live in an extremely cold climate, try wrapping a metre of heat tape around the actuator's motor and gear box and then cover it with foam insulation and a plastic bag to prevent the tape and insulation from getting wet. Once the snow begins to fall, periodically move the antenna to the extreme east or west limits and brush out the snow and ice, or it can accumulate and place a heavier-than-usual load on the dish's actuator motor as well as weigh down the reflector, distorting its shape.

The antenna's plastic LNB/feedhorn cover provides your system's sensitive microwave components with additional protection from the elements. Take a moment to inspect the cover to ensure that moisture isn't gaining entry through a crack or seam. Also make sure that the feedhorn's plastic cap is tightly in place. This will prevent moisture from blowing into the throat of the feed, where it could freeze and thereby prevent the feedhorn's pick-up probe from freely rotating.

INSTRUMENTS FOR SATELLITE WORK

Correct alignment of the receiving antenna and feedhorn polarization is essential if maximum system performance is to be obtained. What's more, the achievement of the highest possible signal levels will provide a measure of margin above receiver threshold that will help to counteract any Ku-band signal degradations due to rain fade. The fastest and most reliable method of achieving optimum results during the installation procedure, or whenever attempting to locate faulty system components during troubleshooting, is to use an instrument to actually measure the signal strength and carrier to noise (C/N) ratio of the incoming satellite signals.

Instruments which measure the signal level of the satellite receiving system vary greatly in price and function. Some of these instruments even will not only measure the block IF signal output of the LNB (950 to 2150 MHz) but also the signal levels of terrestrial radio transmissions from about 40 to 860 MHz. These devices can therefore be used for a variety of signal measurement purposes, including but not limited to satellite applications. The following summary explains the applications, benefits and approximate prices (in Australian currency without sales tax) of the different types of instruments which currently are available.

SIGNAL METERS

One low-cost basic type of signal level measurement device uses a common multimeter to measure the Automatic Gain Control (AGC) voltage supplied by the satellite receiver, which varies linearly in relation to the incoming satellite signal level. Unfortunately, this indirect method of signal measurement is not highly accurate and many receivers do not provide an easy way for technicians to tap into the AGC voltage. One benefit of the AGC measurement method is that the level of each satellite TV channel can be checked individually. Because the AGC voltage readings are not calibrated, however, there is no way to accurately measure the incoming signal strength and carrier to noise (C/N) ratio of the incoming signals.

A small, light-weight and inexpensive satellite signal meter such as the SF90 (less than $70) is a more practical device which every satellite technican should have as a part of his tool kit. This satellite signal meter can be easily inserted into the coaxial cable which links the LNB and receiver. The same voltage sent by the receiver to power the LNB also provides power to the SF90, so no battery or other power source is required to operate the instrument. One disadvantage of this type of signal meter is that it measures all of the signals coming from the satellite at once, so it is of little assistance in making polarization adjustments. The meter readout also is not calibrated, so measurement of actual signal level system C/N is not possible.

More advanced signal measurement devices such as the Sadelta TC60 (about $1,000) can be used to provide a much wider range of signal measurements. This type of instrument has an internal power supply so that the antenna and feedhorn can be precisely aligned without a receiver in sight. Moreover, the TC60 is fully tunable from 950 - 2100

FIG. 11-1. THE SF90 SATELLITE SIGNAL METER.

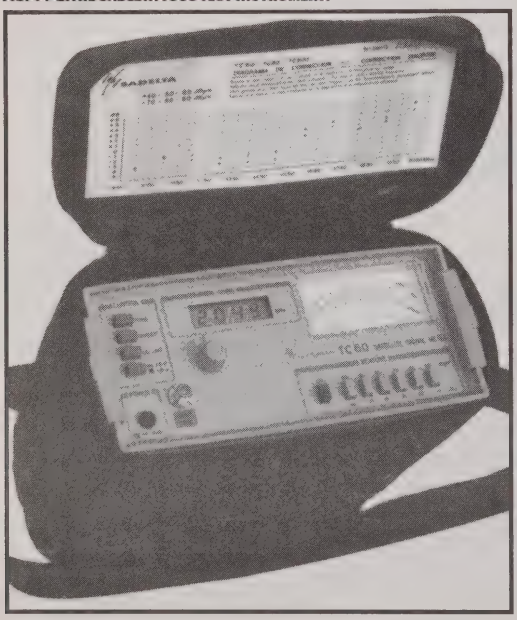
MHz, so the instrument can be adjusted to zero in on any individual satellite transponder of interest. A sweep function allows fast location of any satellite transmission from a given orbital slot. Then once the instrument is tuned to a particular I.F. frequency it will read actual signal level in either dBm or dBμV. The TC60 also can be used to make accurate system C/N measurements, or even to analyse SMATV system performance. The unit's LNB supply can be switched between 14 and 18 volts, which facilitates the precise adjustment of feedhorn polarization. The TC60 also offers a tone function that allows the signal level to be peaked by variations in the pitch of an audio tone. LNB current also can be measured so that technicians can quickly identify an excessive current draw from a faulty LNB.

SPECTRUM ANALYSERS

Spectrum analysers often are used to visually display the incoming satellite signals. The passband of the spectrum analyser can be adjusted to display any portion of the satellite band of interest, from a single satellite signal all the way to the entire frequency band transmitted by any given satellite. Signals appear on the analyser's screen as "spikes" which rise up from a background noise or "hash line" displayed at the bottom of the screen. Low-cost spectrum analysers provide a relative, non-calibrated measurement of signal level, while higher-priced units typically can be calibrated to an accuracy level of about ±1 dB.

Some of the portable, battery-operated

FIG. 11-2. THE SADELTA TC60 TEST INSTRUMENT.

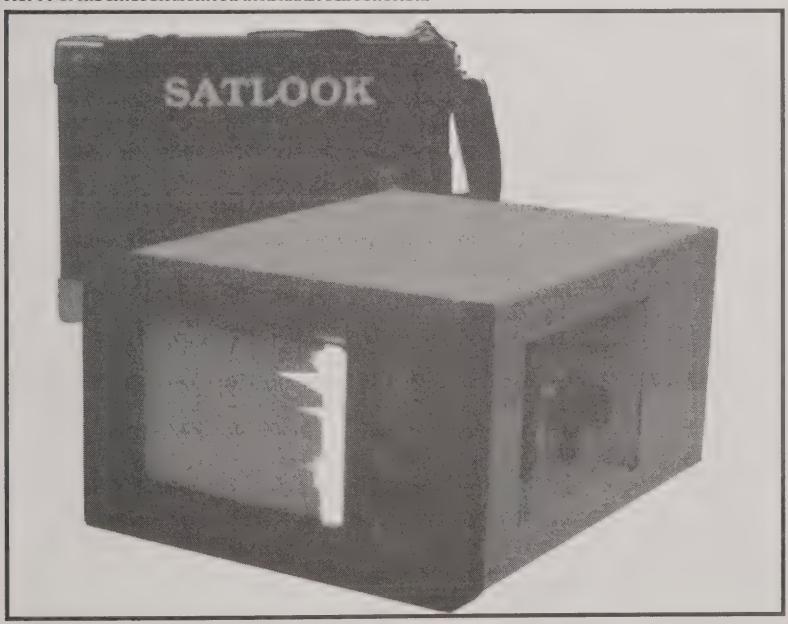


spectrum analysers used for TVRO applications even contain a satellite TV receiver. The display screens for these units can therefore be switched to either display signal levels or an analogue TV picture.

The SATLOOK ($995), for example, provides an uncalibrated spectral display screen with monitor function, an LNB power source and a polarization switching voltage, all contained in a small hand-held case. Also provided: an audio tone which varies in pitch in direct relation to the level of the incoming satellite signal so that the technician can tweak the antenna without actually needing to see the screen.

The more expensive units, such as UNAOHM's EP805 ($2,700), feature a calibrated spectral display with an accuracy of better than ±1.5 dB. The EP805, which covers the 950 to 2050 MHz IF spectrum, also offers a comprehensive range of auxiliary functions which includes the display of video sync. pulse and color burst as well as a C/N signal level readout. Features include a 14/18 volt switchable LNB power supply and a video inversion switch for the correct display of clear PAL C-band satellite signals. An optional Calibrated Noise Generator also is available which can be used to measure the frequency response of cables, filters, amplifiers and other system components. Reflectometer measurements, which indicate the distance in a cable to a short or open circuit, also can be made with this device by using a BNC T connector and a special calibrated slide rule, both provided with the

FIG. 11-3. THE SATLOOK MONITOR WITH ANALYSER FUNCTION.



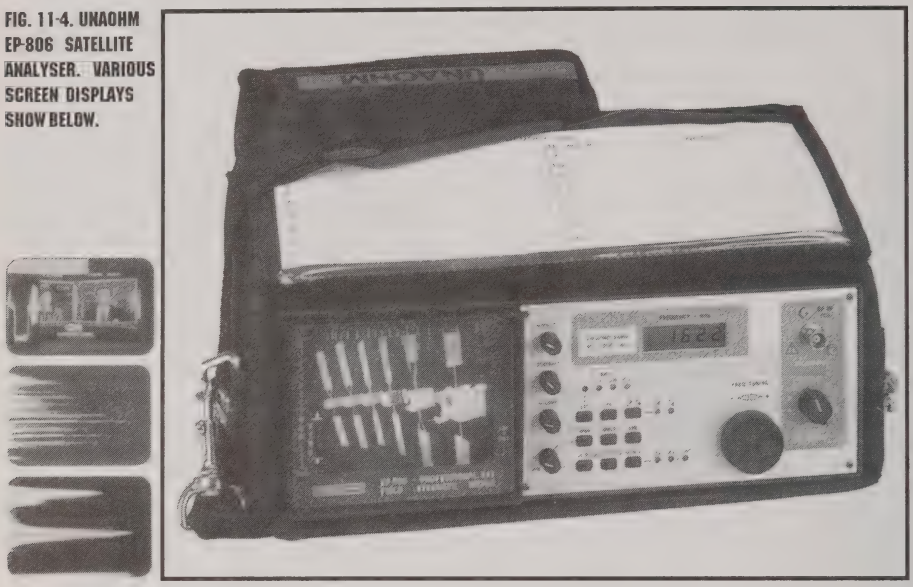


FIG. 11-4. UNAOHM EP-806 SATELLITE ANALYSER. VARIOUS SCREEN DISPLAYS SHOW BELOW.

unit.

All of the above mentioned instruments are analog measurement devices. The new digital hand-held instruments now available have deliberately been excluded from consideration here because the digital nature of these devices limits their ability to faithfully display the incoming signals. First of all, these digital instruments retrace or "refresh" their screens at a relatively slow rate when compared to their analogue counterparts. Since analogue satellite TV transmissions are continually changing in terms of intensity and spectral density, the technician may not actually see the true peak value of the signal, or the technician may have difficulty in seeing minor improvements or degradations in signals levels which will occur while the antenna or feedhorn alignment is being adjusted. Furthermore, the step tracking nature of the tuning system used by these digital instrument keeps signals which may fall between the steps from being accurately represented on the display screen. This can be a limiting factor for technicians who are attempting to track down interference problems.

WSTV 12

HOW TO RECEIVE INTERNATIONAL SATELLITE SIGNALS

There are numerous international satellites which can be received from locations throughout Asia, Australia, New Zealand and the South Pacific. Reception of these satellite signals often requires specialized equipment and expertise. The following chapter will present you with all the information that you'll need to succeed in receiving the available international TV and radio signals.

THE INTELSAT SATELLITES

There are three distinct classes of INTELSAT satellites which provide telecommunications services within the Asia/Pacific region: the INTELSAT V series, the INTELSAT VI series and the INTELSAT VII series. Launched during 1980s, the INTELSAT V satellites have large solar wings which span more than fifty-one feet. This large solar array produces the power to operate more than twenty C-band and six Ku-band transponders simultaneously. All of the INTELSAT V series satellites which remain in operation have exceeded their predicted nominal mission lifetimes of seven years.

Launched during the early 1990s, two INTELSAT VI series satellites provide telecommunications services from orbital assignments over the Indian Ocean. INTELSAT VI satellites have a solar array that is attached to the surface of a cylindrical drum which spins at a fixed rate to maintain constant illumination by the Sun. The central portion or "payload" of the satellite, which carries the antennas and transponders, has a fixed position to maintain continuous coverage of the Earth below. INTELSAT VI series satellites carry higher powered amplifiers than the INTELSAT V spacecraft, which means that smaller anten-

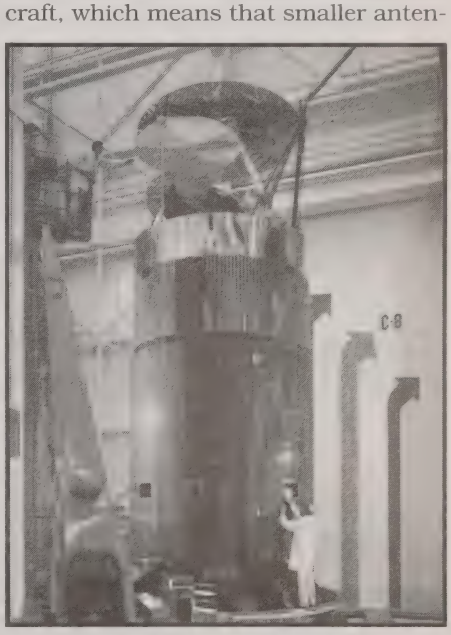


FIG. 12-1. INTELSAT VI. (COURTESY INTELSAT.)

nas can be used down on the ground to receive their transmissions.

INTELSAT VII series satellites are the first INTELSAT spacecraft to be specifically designed for coverage of the Asia/Pacific region. The first in the new series of INTELSAT VII satellites was launched on October 22,1993.

INTELSAT VII satellites feature a seventy-one foot solar array which produces more than 4,000 watts of electrical power. This latest generation of INTELSAT satellites carry higher powered amplifiers than the INTELSAT V or INTELSAT VI spacecraft, which will allow them to be used for just about any application, including medium-power direct-to-home TV transmissions.

Two INTELSAT VII satellites are currently providing follow-on service for the Pacific Ocean Region from 174 (INTELSAT 701) and 177 (INTELSAT 703) degrees east longitude. Two additional INTELSAT VII spacecraft (INTELSAT 702 and 704) currently are serving users in the Atlantic and Indian Ocean Regions. Five additional INTELSAT VII (including four specially enhanced INTELSAT VII-A) satellites are scheduled to be launched within the next two years.

INTELSAT SATELLITE COVERAGE BEAMS

INTELSAT satellites carry four types of beam antennas: global, hemispheric, zone and spot. The type of beam can be selected by ground command for routing TV programs and other telecommunications traffic to their intended destinations.

Global Beams. The global beam footprint pattern covers the largest amount of surface area of the Earth—up to 42 percent from any given orbital location. The global beam has been used by the INTELSAT organization since the launch of its first series of satellites in the 1960's. These days, INTELSAT global beams are widely used to send TV news, sports and entertainment feeds from one hemisphere to the other. These feeds range from short news items of three minutes or less to complete coverage of sports competitions or other major events.

Because the satellite transponder's signal is projected over such a vast area, large dish antennas are usually required

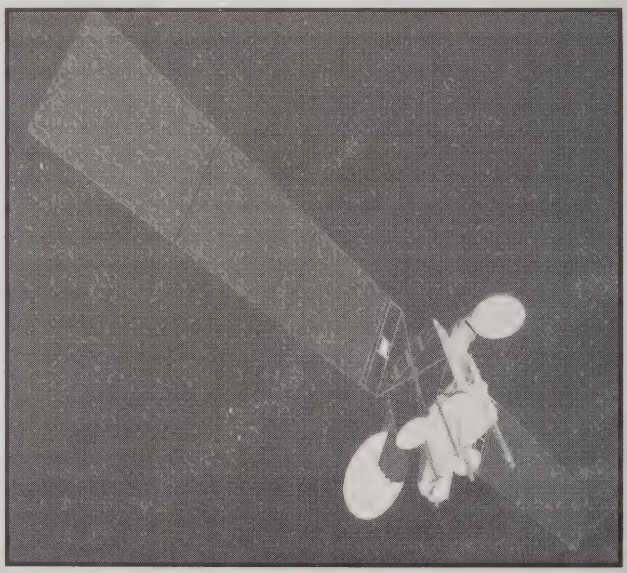
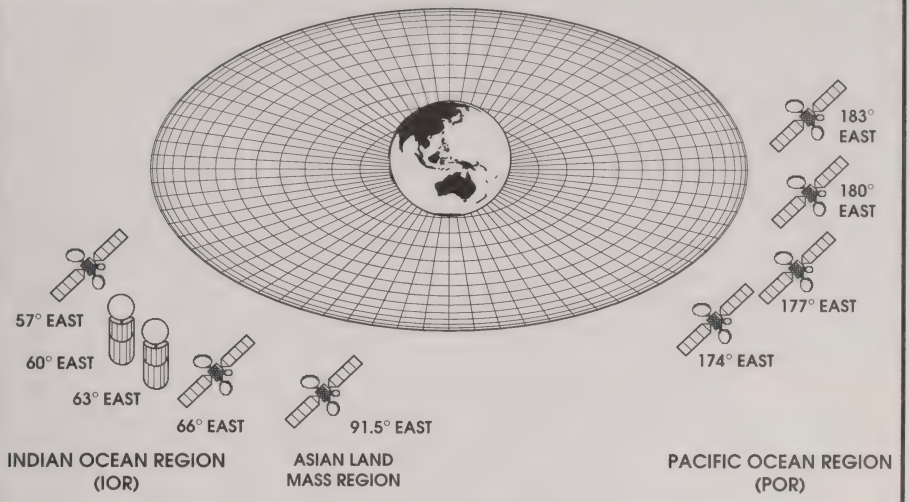


FIG.12-7. INTELSAT VII (COURTESY INTELSAT.)



INTELSAT V SATELLITES

F1 Status: Asian Region contingency spare with domestic/international services.
Location: 91.5° E [268.5° W.]

F3 Status: Pacific Ocean contingency spare.
Location: 183° E. [177° W.].

F7 Status: Indian Ocean contingency spare.
Location: 57° E. [303° W.].

F11 Status: Pacific Ocean spare with domestic services.
Location: 180° E./W.

INTELSAT VI SATELLITES

F2 Status: Indian Ocean [formerly major path/primary] satellite.
Location: 63° E. [297° W.].

F4 Status: Indian Ocean contingency spare with domestic/international services.
Location: 60° E. [300° E.].

INTELSAT VII SATELLITES

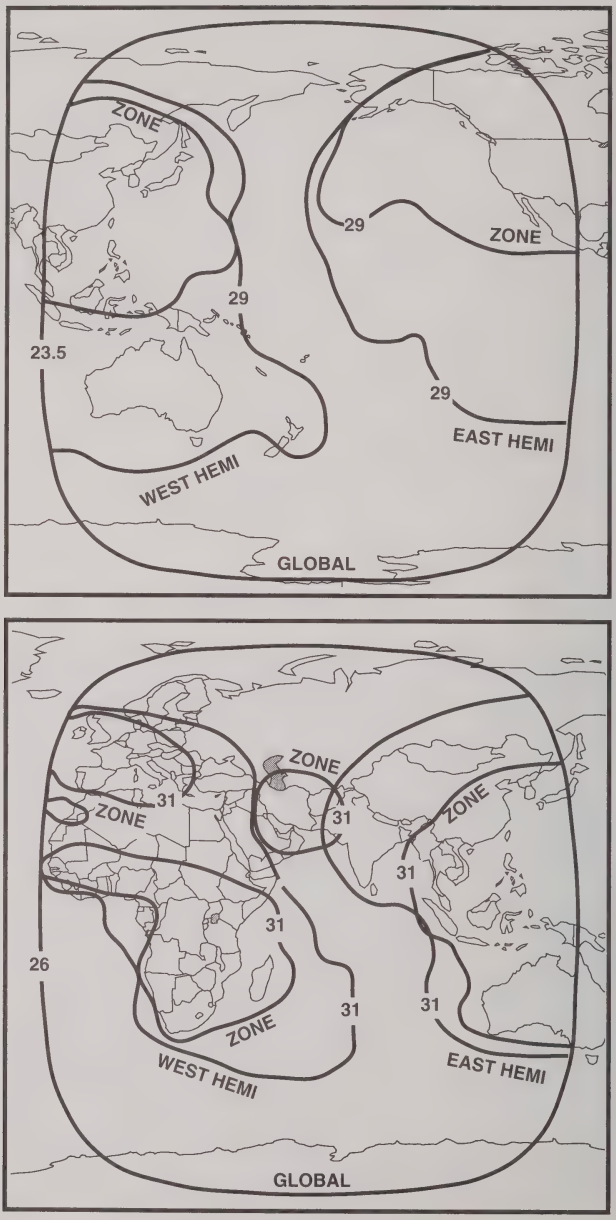
F1 Status: Pacific Ocean (formerly primary path) satellite.
Location: 174° E. [186° W.].

F3 Status: Pacific Ocean contingency spare.
Location: 177° E. [183° W.].

F4 Status: Indian Ocean contingency spare.
Location: 66° E. [294° W.]

FIG. 12-3. INTELSAT SATELLITES SERVING THE ASIA/PACIFIC REGION (AS OF AUGUST 15, 1995)

FIG.12-4. INTELSAT GLOBAL, HEMISPHERIC, ZONE AND SPOT BEAM COVERAGE FROM 180° EAST LONGITUDE (TOP—INTELSAT 508) AND 63° EAST LONGITUDE (BOTTOM—INTELSAT 605) THE LIMIT OF THE GLOBAL COVERAGE IS INDICATED BY THE LARGE SIZE OVAL. THE KIDNEY SHAPED BEAMS TO THE EAST AND WEST OF MAP CENTER ARE THE HEMISPHERIC BEAMS AND THE SMALLER BEAMS NORTH (TOP) OR NORTH & SOUTH (BOTTOM) OF THE EQUATOR ARE THE ZONE BEAMS.



in order to receive these thinly spread signals. The exact size of antenna required, which will vary depending on how much power the particular INTELSAT satellite puts into the global beam, typically ranges from five to ten meters in diameter.

Hemispheric Beams. Several countries, within the Asia/Pacific region, including Australia, Malaysia, and Thailand, have long used INTELSAT hemispheric beam transponders to transmit television programming. The hemispheric beam coverage area is reduced to less than half of the global beam area, covering approximately 20 percent of the Earth's surface to the east or west of the satellite's orbital location. This allows smaller and less expensive receiving antennas to be used down on the ground. Satellite antennas in the three to six meter range typically are required to produce a high quality signal when receiving these hemispheric beam transmissions.

Zone Beams. The zone beam transmits its signal into an area less than half the size of a hemispheric beam. This doubles the signal intensity, allowing dishes four meters in diameter to perform effectively. INTELSAT V satellites feature northeast and northwest zone beams which reach locations above the Earth's equator, while INTELSAT VI and VII series spacecraft provide northeast, southeast, northwest and southwest zone beams.

Spot Beams. INTELSAT V and INTELSAT VI satellites carry two steerable Ku-band spot beams that can be commanded to point at any location north of the Earth's equator that is visible from the satellite's orbital position. In addition to these Ku-band spot beams, a few of the last-to-be-launched INTELSAT V satellites were specially adapted to also carry steerable C-band spot beams. Both the C- and Ku-band spot beams, which are tightly focussed to provide coverage of relatively small areas of the Earth's surface, can deliver domestic television and telecommunications services into small-aperture antennas that are located within their respective coverage areas.

The INTELSAT VII series features a total of three fully steerable Ku-band spot beams and one fully steerable C-band spot beam. These beams can be steered to cover any location on Earth that is visible from the satellite's orbital location.

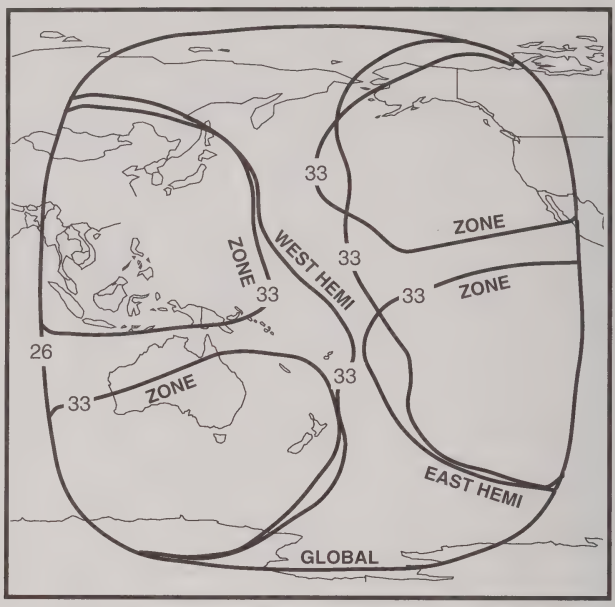
INTELSAT POLARIZATION STANDARDS

All INTELSAT C-band satellite transmissions use circular polarization. Instead of positioning the microwave energy in a vertical or horizontal plane, circular polarization is transmitted in a helical pattern, with the wave front rotating either clockwise right-hand circular) or counter-clockwise left-hand circular) as viewed from the satellite.

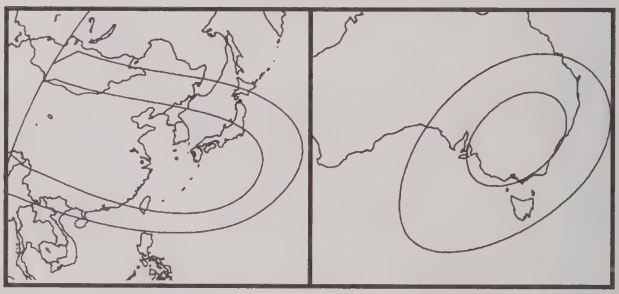
INTELSAT satellites are capable of transmitting both right-hand and left-hand circularly polarized signals simultaneously within any given area of the Earth. This allows the limited C-band frequency range to be used twice without causing interference.

For example, INTELSAT V and VI series satellites use right-hand circular polarization for their hemispheric beams and left-hand circular polarization for their zone beams. This is referred to as

FIG.12-5. INTELSAT 701 C-BAND GLOBAL, HEMISPHERIC, & ZONE AND KU-BAND SPOT BEAM COVERAGE FROM 174° EAST LONGITUDE. THE LIMITS OF THE GLOBAL COVERAGE IS INDICATED BY THE LARGE SIZE OVAL. THE KIDNEY SHAPED BEAMS TO THE EAST AND WEST OF MAP CENTER ARE THE HEMISPHERIC BEAMS AND THE SMALLER BEAMS NORTH & SOUTH OF THE EQUATOR ARE THE ZONE BEAMS.



C-BAND GLOBAL, HEMISPHERIC & ZONE BEAMS



REPRESENTATIVE KU-BAND SPOT BEAM COVERAGE

cross-polarization and allows simultaneous use of hemispheric and zone beams in both the westerly and easterly directions.

Instead of circular polarization, the INTELSAT V and VI series satellites have steerable Ku-band spot beams which use linear polarization. The west spot beam is horizontally polarized on the downlink side while the east spot beam is vertically polarized. INTELSAT VII series satellites also have this capability as well as a third steerable spot beam which also uses linear polarization.

FIG. 12-6. INTELSAT SATELLITE FREQUENCY VERSUS BEAM COVERAGE COMPARISON CHART.

TR No.	Freq. MHz	INT V	INT VI	INT VII
00	3685	———	H & Z	———
01	3725	H & Z	H & Z	H & Z
02	3765	H & Z	H & Z	H & Z
03	3805	H & Z	H & Z	H & Z
04	3845	H & Z	H & Z	H & Z
05	3885	H & Z	H & Z	H & Z
06	3925	H & Z	H & Z	H & Z
07	3975	H & Z	H & Z	H & Z
08	4015	G or H & Z	H & Z or G	H & Z or G
09	4055	H or G†	H & G or S	H & Z or G &/or S
10	4095	G†	G &/or S	G &/or S
11	4135	G†	G &/or S	G &/or S
12	4175	G†	G &/or S	G &/or S

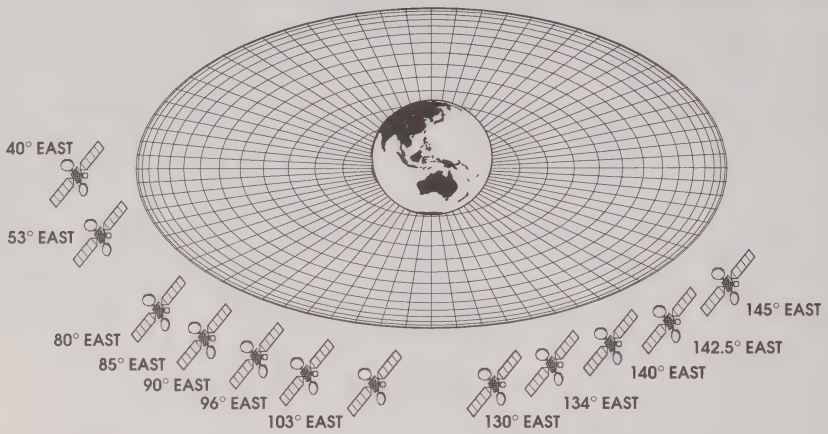
† Some of the later INTELSAT V flight models (INTELSAT 510~515) also can connect these transponders to a steerable C-band Spot Beam
S = C-band Spot Beam
H = East and West Hemispheric Beams
Z = Northeast and Northwest Zone Beams on INTELSAT V, Northeast, Northwest, Southeast and Southwest Zone Beams on INTELSAT VI and INTELSAT VII.
G = Global Beam

THE STATSIONAR SATELLITE SYSTEM

Like INTELSAT satellites, the STATSIONAR "Gorizont" (Russian for "horizon") spacecraft carry four types of beam antennas: global, hemispheric, zone, and spot. Russian ground control stations can select between global, hemispheric, zone, and spot beam antennas on designated transponders for maximum versatility. While INTELSAT's hemispheric and zone beams cover the eastern and western portions of the globe, the Gorizont hemispheric and zone beams are biased to maximize coverage of locations north of the Earth's equatorial region.

Gorizont satellites at 40, 53, 80, 85, 90, 96, 103, 140 and 145 degrees east longitude offer several channels of Russian television bound for different time zones within the Russian Federation. These satellites also extend Russian and—via the Indian Ocean STATSIONAR satellite at 80 degrees east longitude—INTERSPUTNIK satellite coverage into much of Africa, Asia, and the Pacific Ocean Region. International news exchanges involving countries such as Laos, Viet Nam, and Cambodia can be found on this satellite.

During the past two years, the Russian Space Agency has launched several new satellites to orbital locations over the Pacific Ocean. These satellites, which are operated by INTERSPUTNIK, are located at 130, 134 and 142.5 degrees east longitude. These STATSIONAR "R" satellites are being used to transmit TV



STATSIONAR-12 Status: Gorizont 22 with domestic and international services.
Location: 40° E. [320° W.].

STATSIONAR-5 Status: Gorizont 27 with domestic and international services.
Location: 53° E. [307° W.]

STATSIONAR-13 Status: Gorizont 24 with domestic, international and INTERSPUTNIK services.
Location: 80° E. [280° W.].

STATSIONAR-6 Status: Gorizont 28 with domestic Russian TV services.
Location: 90° E. [270° W.].

STATSIONAR-8 Status: Gorizont 19 with domestic Russian TV services.
Location: 95° E. [265° W.].

STATSIONAR-21 Status: Gorizont 25 with domestic Russian TV services.
Location: 103° E. [257° W.].

STATSIONAR-7 Status: Gorizont 18 with domestic Russian TV services.
Location: 140° E. [220° W.].

STATSIONAR-16 Status: Gorizont with domestic Russian TV services.
Location 145° E (215° W.).

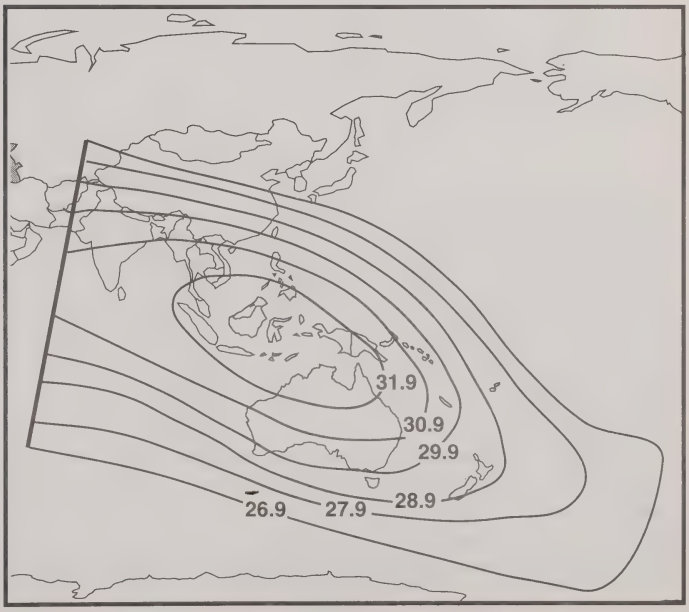
STATSIONAR-R2 Status: Gorizont 30 with TV lease services for India and Russia..
Location: 142.5° E. (217.5° W.).

STATSIONAR-R3 Status: Gorizont 17 with international lease services.
Location: 134° E. (226° W.).

STATSIONAR-R1 Status: Gorizont 29 with TV lease services for India.
Location: 130° E. (230° W.).

FIG. 12-7. STATSIONAR SATELLITE DEPLOYMENT (AS OF AUGUST 15, 1995.)

FIG.12-8 & 12-9. STATSIONAR HIGH POWER GLOBAL (TOP) AND EAST HEMISPHERIC (BOTTOM) BEAM COVERAGE FROM T42.5°EAST LONGITUDE.



services to cable TV systems in India. INTERSPUTNIK intends to begin deploying a new series of Russian Express satellites to orbital positions in the Indian and Pacific Ocean Regions beginning in 1996.

STATIONAR satellites in the Indian and Pacific Ocean Regions currently transmit full-time TV program services to Russia, India, Sri Lanka, the Philippines, and Azerbaidjan.

When they are not already transmitting video signals, the active Gorizont TV transponders often display a test pattern. The spot beam (3675 MHz) transponder carried by all of the above mentioned STATSIONAR satellites typically is used to transmit full-time TV programming. These spot beam transmissions are so powerful, that antennas as small as three feet in diameter can be used to receive the signals at locations within the central contours of the beam. What's more, reception at locations which are far removed from the center of the coverage beam also is possible if a large enough antenna is used.

PAS-2

PanAmSat is a privately-owned international satellite operator based in the United States. The company began operating its first international satellite, PAS-1, in the Atlantic Ocean Region in 1988. In 1994, PanAmSat launched a second international satellite, PAS-2, for operation in the Pacific Ocean Region.

PAS-2 is a dual-band satellite which carries sixteen C-band and sixteen Ku-band satellite transponders. Twelve transponders in each frequency band are 54 MHz wide, and four transponders in each frequency band are 64 MHz wide. The satellite's C-band transponders either connect to one of four different Pacific Rim beams (which includes coverage of Australia and New Zealand) or an Oceania beam, while the Ku-band transponders connect to either one of two China beams, a Northeast Asia beam, or an Australia/New Zealand beam. (See the following PAS-2 C- and Ku-band Frequency Plans on pages 159 & 161).

Unlike the INTELSAT, INTERSPUTNIK, and Rimsat satellites previously described in this chapter, PAS-2 uses linear (horizontal/vertical) rather than circular polarization as its transmission standard, so no special circularly polarized feed is required to optimize reception. Moreover, PAS-2 uses powerful 34-watt C-band and 63-watt Ku-band amplifiers which feed into special "shaped beam" antennas that concentrate the signals over the region's most strategic population centers. Small aperture antennas therefore can be used at these location to pick up video transmissions.

PAS-2 is extensively used by American-based cable program services such as ANBC, The Cartoon Channel, CNN International, Country Music Television (CMT), Discovery Channel, ESPN, MTV Asia, Primestar, and Viacom International to relay Asian versions of their services into the region. What's more, Asian-based programmers such as ABS-CBN (The Philippines), TVB International (Hong Kong) and CCTV (China) use the satellite to distribute programming throughout the region. International news organizations such as CBS (USA) and NHK (Japan) also use PAS-2 to relay news feeds to affiliated broadcasting organizations in the Asia/Pacific region.

In August of 1995, PanAmSat launched its PAS-4 satellite to an orbital assignment of 68.5 degrees east longitude over

FIG. 12-10. PAS-2 C-BAND PACIFIC RIM BEAM, EIRP VALUES IN DBW.

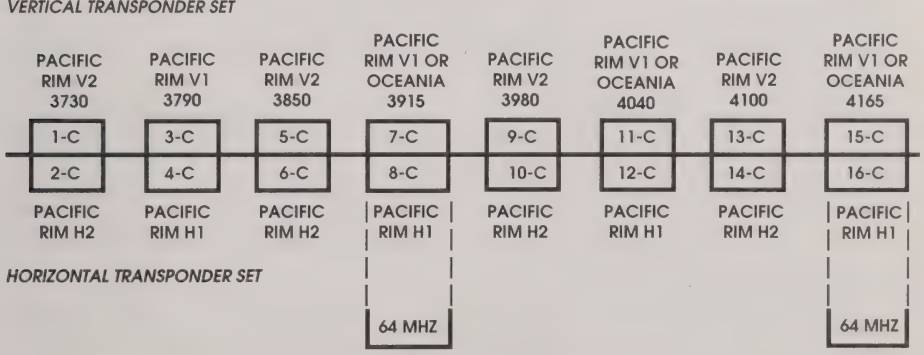
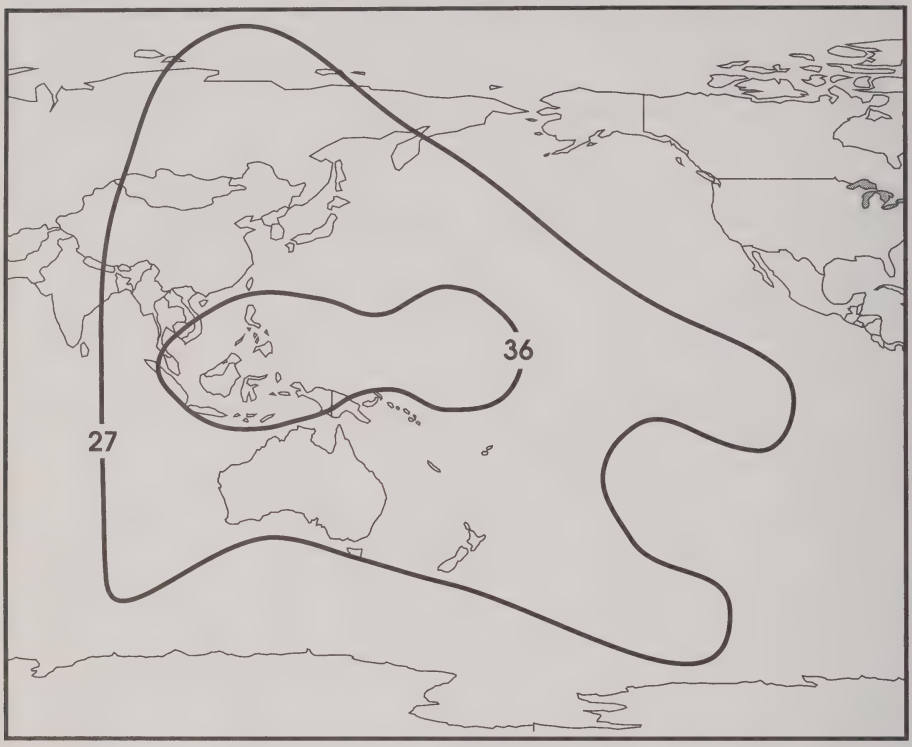


FIG. 12-11. PAS-2 C-BAND DOWNLINK FREQUENCY PLAN. (ALL FREQUENCIES IN MHZ).

FIG. 12-12. PAS-2 C-BAND OCEANIA BEAM, EIRP VALUES IN DBW.



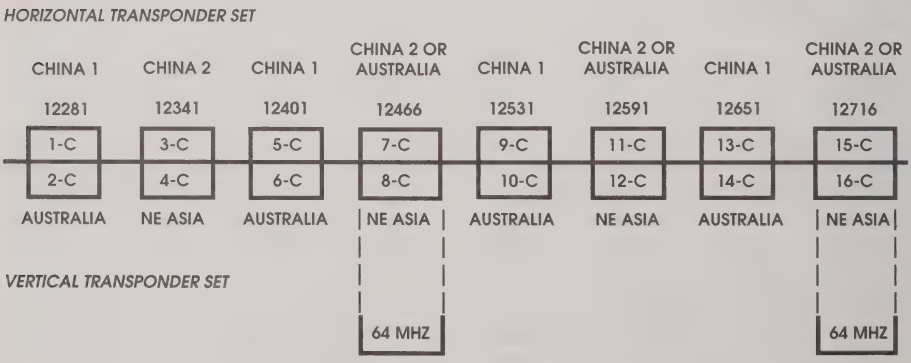


FIG. 12-13. PAS-2 KU-BAND DOWNLINK FREQUENCY PLAN. (ALL FREQUENCIES IN MHZ).

FIG. 12-14. PAS-2 KU-BAND AUSTRALIA & CHINA BEAMS, EIRP VALUES IN DBW.

the Indian Ocean. The new dual-band PAS-4 satellite can be received from locations in Australia but not New Zealand.

RECEIVING INTERNATIONAL SATELLITE SIGNALS

Although the reception of INTELSAT and STATSIONAR satellite TV signals often requires the use of large antennas, they are delivering satellite TV programming to areas such as Australia, New Zealand and the South Pacific where there is a limited range of services from domestic satellites, as is the case in Australia, or no service at all.

The appropriate dish size for INTELSAT or STATSIONAR satellite reception at your location will depend on which beam pattern is being used by the particular services you wish to view. INTELSAT and STATSIONAR reception also often requires the use of special satellite feedhorns, receivers, and antenna tracking devices in order to obtain a high-quality picture.

Circular Polarization. For the best possible reception of INTELSAT and STATSIONAR satellites, you will need to change your feed polarization from horizontal/vertical (which is used by the

Palapa, AsiaSat, Apstar and PAS satellites) to circular polarization. Instead of positioning the microwave energy in a plane, whether vertical or horizontal, circular polarization is transmitted in a circular pattern, that rotates in either a clockwise or a counter-clockwise direction. Although your regular feedhorn can still pick up circularly polarized signals, you end up losing half of the available signal. This can make the difference between a noise-free picture and one that is not tolerably viewable.

Special international feedhorns have been created which can receive both linearly and circularly polarized satellite signals, so that you can receive programming from the international satellites as well as regional satellites such as Palapa or PAS. These products are available from manufacturers such as National ADL, Seavey Engineering, and Chaparral Communications.

When your feedhorn skew is adjusted to optimally receive right hand circularly polarized (RHCP) signals, you will be unable to see any left hand circularly polarized (LHCP) signals, and vice versa. This cross-polarization isolation is identical to the isolation between the horizontal and vertical polarizations used by domestic and regional satellites. To maximize your reception of both circular and linear satellite transmissions be sure to follow the installation instructions provided by the feedhorn manufacturer when installing the feed on your system.

International Frequency Scheme. The INTELSAT V and VII series satellites, as well as PAS, transmit to Earth using C-band frequencies in the 3.7 to 4.2 GHz range, while INTELSAT VI and STATSIONAR satellites transmit to Earth using the 3.65 to 4.2 GHz frequency range. The transponder numbering and center frequencies for INTELSAT, PAS, and STATSIONAR channels differ somewhat from what regional satellites such as AsiaSat and Palapa use. Satellite TV receivers and IRDs which incorporate programmable tuning will give your system added flexibility when pulling in international signals.

Video Bandwidth. INTELSAT and PanAmSat sometimes transmit TV signals using only half of a transponder's available bandwidth. This is typically the case when INTELSAT transmits short duration news feeds on one of its global beam transponders. When receiving "half-transponder" signals, the receiver

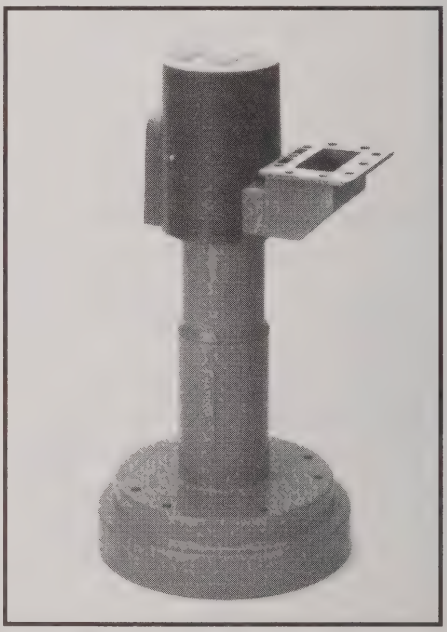


FIG. 12-15. CIRCULAR/LINEAR FEEDHORN. (COURTESY OF NATIONAL ADL.)

bandwidth must be narrowed from its normal wide setting to less than 20 MHz (INTELSAT) or 27 MHz (PAS) in order to obtain optimum system performance.

Even when a satellite signal occupies the entire transponder, your system may not receive enough signal to produce a good picture. This is often the case when the antenna isn't large enough to gather a sufficient amount of signal. Many of today's receivers come with adjustable bandwidth filters built into them. These filters can be adjusted on a channel-by-channel basis to provide optimum reception of each available satellite TV service. Once you have determined the best filter setting, you can store that setting in the receiver's memory circuit for automatic recall any time that you select that channel for viewing. If you have a satellite receiver which does not have a built-in bandpass filter, you can purchase an outboard filter and connect it to the second IF loopthrough ports (usually labeled "IF IN" and "IF OUT") on the receiver's back panel. The frequency of the filter you buy also must match the IF loopthrough frequency scheme of the receiver. This information is either provided on the receiver's back panel or in the receiver's instruction manual.

While a bandpass filter can be used to remove impulse noise or "sparklies" from your reception of the weaker international satellite TV channels, you will need to readjust the filter setting each

FIG. 12-16. MONTERAY 140 INTERNATIONAL SATELLITE RECEIVER. (COURTESY CHAPARRAL COMMUNICATIONS.)

time you change channels to get the best possible performance out of your system.

There are limits to the effectiveness of using filters to improve satellite reception. Exact reproduction of video color and detail requires that the satellite receiver process an incoming signal's total transmitted bandwidth. By narrowing the filter's bandwidth, you remove the portion of the signal that contains the greatest amount of noise. The image will be noticeably improved, but some color fidelity and picture detail will be lost.

Audio Companding. The audio portion of some of the Russian satellite TV services using 7.0 or 7.5 MHz audio subcarriers has been compressed or "companded" and consequently sounds distorted on receivers not equipped to re-expand it at the receive end. A special add-on audio filter is needed to restore the audio to its original format.

Energy Dispersal (ED). Energy dispersal systems insert a constantly changing waveform into the video, preventing the carrier from ever resting on its main frequency. ED also spreads the power of any transponder across its total bandwidth; this prevents the satellite transmissions from causing interference to ground-based services using the same frequencies. The ED waveform is filtered out of the video at the TVRO receiver terminal. The dispersion removal circuits used by most satellite receivers may not entirely take out the ED waveform used by STATSIONAR satellites. In some cases, the receiver's automatic frequency control circuit can be modified to do the job.

COPING WITH VIDEO STANDARDS

On AsiaSat 1 alone, satellite TV viewers will encounter all three of the basic color transmission systems being used around the world today: NTSC, PAL, and SECAM. To view all three video standards will require the use of a multistandard monitor, a standards converter, or a special VCR that converts the TV transmissions from their original standard to one that can be displayed by your regular TV set.

Digital Compression has added to the number of different transmission standards in use around the world. Regrettably each standard of digital compression requires a special receiver that is unlikely to be compatible with other digital transmissions. However most digital receivers in use in Australia and New Zealand include circuitry that generates outputs in the international PAL standard.

NTSC. Named after the U.S. National Television Standards Committee which selected this method of color coding back in 1953, NTSC utilizes a separate 3.58 MHz "chroma" subcarrier to contain the color information. NTSC is used for all of STAR TV's Northern Beam broadcasts on Asiasat 1. The countries within the region using NTSC include Japan, South Korea, Taiwan, and the Philippines.

SECAM. The French system is called SECAM (for Sequence a Memoire). This system FM modulates the color information onto two subcarriers which are then recombined at the television set. Within the region, SECAM is currently used for satellite broadcasting by member coun-

tries of the Commonwealth of Independent States, Vietnam, and Mongolia.

PAL. A third system, developed by the Germans, is called PAL (for Phase Alteration by Line). This system is used to transmit all of STAR TV's Southern Beam broadcasts on Asiasat 1. The countries within the region using PAL for satellite broadcasting include Australia, Indonesia, Malaysia, New Zealand, Thailand, and the People's Republic of China.

Multi-standard monitors and receivers are available so that you can view overseas satellite TV signals in full color. Some models will automatically detect and display the correct standard. Both Instant Replay and Panasonic offer special VCRs that will convert PAL, SECAM, and NTSC signals so that you can record them for later viewing, or view them live on any TV set in your home. We would recommend one of these for any first-class international earth station installation.

You also can receive a black and white picture from any standard on any television. When receiving 625-line video on an NTSC monitor, first readjust the set's vertical hold control to stop the picture from "rolling". Then readjust the vertical linearity control to reduce the picture's height so that the 625-line picture will fit on the screen. The linearity control may be on the back of your set. If this adjustment requires the use of a screwdriver, be sure to use an insulated tool to prevent the possibility of shock.

Before making the linearity adjustment, the top and bottom of the picture appears cut off and everything looks skinnier than it should be. For someone with a 625-line set, the vertical linearity would be adjusted so that the video fills the entire screen. Unadjusted, 525-line video on a 625-line set looks compressed, with no picture present at the very top and bottom of the screen.

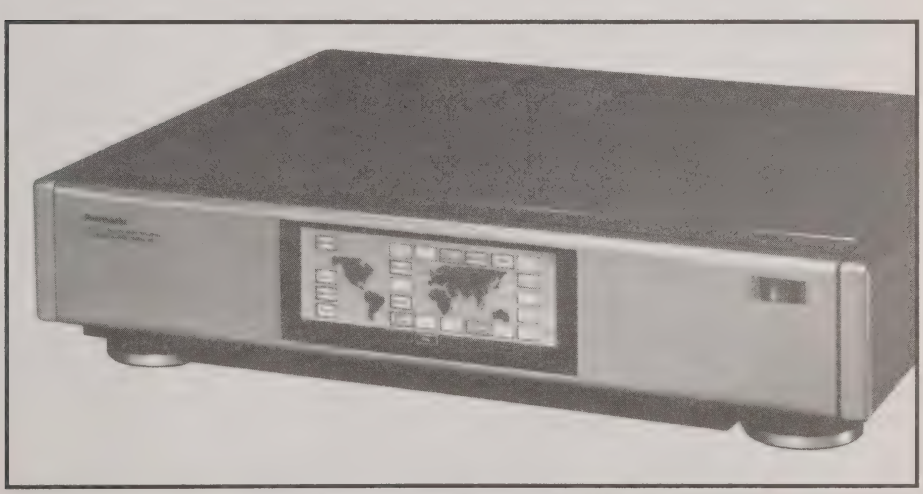


FIG. 12-17. PANASONIC AG-W1 WORLD TV BROADCAST VCR. (COURTESY PANASONIC.)

Switchable Video Deemphasis. Every satellite TV receiver has a deemphasis filter which follows the demodulator stage; slightly different components values are necessary for 525-line video than for 625-line video. If this circuit is not modified, there will be a barely perceptible degradation of the video, more noticeable on marginal signals. Use of the incorrect deemphasis network also can pose problems when recording satellite TV programs with your VCR or interfere with the remodulation schemes used in SMATV or CATV RF signal distribution systems. (See chapter 10 for more information on SMATV and CATV distribution systems.) A few receiver manufacturers provide switchable deemphasis circuits within their products.

TRACKING INCLINED ORBIT SATELLITES

The Sun, the Moon, and the Earth's gravitational field all affect the movement of satellites orbiting the Earth. These natural effects impel telecommunications satellites to wander from their assigned orbital positions over the Earth's equator. The amount of movement can be predicted, with the direction of movement primarily occurring in the north/south direction over 24-hour intervals.

All geostationary satellites are launched with enough station-keeping fuel to counteract the effects of these natural forces for a period of several years, and in the case of the very newest satellites, for up to fourteen years. It is the precise expenditure of fuel at periodic intervals over the lifetime of each spacecraft which permits each satellite to remain continuously on station at its assigned geostationary orbital position.

The controlling engineers for older INTELSAT V satellites, as well as for all of the Russian STATSIONAR satellites, typically cease expending station-keeping fuel once the satellites have expended most of their remaining fuel. Once the north/south station-keeping maneuvers have ceased, the natural forces described above will cause the spacecraft to begin drifting in the north/south direction. This is called an inclined orbit.

During the first few months of inclined orbit operations, the amount of drift in the north/south direction is minimal and is transparent to all but the largest receiving antennas on Earth. Eventually, however, the amount of drift will grow and the satellite's signal will fall outside of each receiving antenna's main beam for portions of each 24-hour orbital inclination period. The amount of inclination will increase at a rate of approximately ±0.85 degrees per year, and as time goes on, the length of the diurnal (twice daily) outages at all receiving stations also will increase.

The only way for a satellite TV system to maintain continuous contact with an inclined orbit satellite is to add a second motor drive to permit the operator to make periodic adjustments to the antenna's declination setting. An adjustment of the antenna's elevation angle alone will not move the antenna along the satellite's north/south path unless the satellite receiving system is located at a longitude that is less than 10 degrees from the longitudinal location of an inclined orbit satellite.

The least expensive way to track the movements of an inclined orbit satellite is to add a second actuator, which replaces the antenna's declination bracket, and an actuator controller. The operator can then manually make adjustments periodically to keep the inclined orbit

FIG. 12-18. MOVEMENT OF AN INCLINED ORBIT SATELLITE IN THE NORTH-SOUTH DIRECTION DESCRIBES A FIGURE-EIGHT PATTERN WHICH TO ALL INTENTS AND PURPOSES APPEARS AS A STRAIGHT LINE TO THE RECEIVING ANTENNA.. (COURTESY STEPHEN J. BIRKILL.)

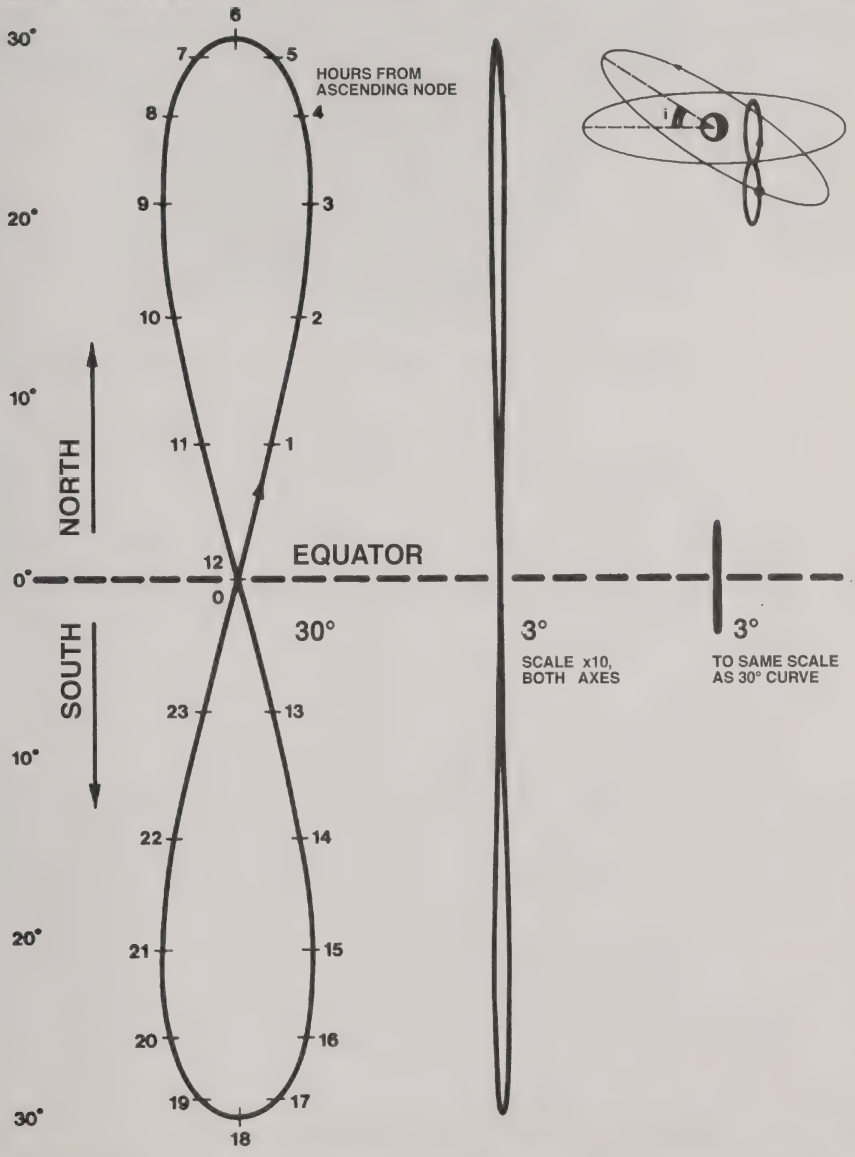


FIG. 12-19. THE CHAPARRAL INCLINED ORBIT TRACKER (IOT-1) IS A DUAL-AXIS ANTENNA TRACKING ACCESSORY THAT GIVES SELECTED CHAPARRAL RECEIVERS AND IRDS THE ABILITY TO FOLLOW THE MOVEMENTS OF INCLINED ORBIT SATELLITES. (COURTESY CHAPARRAL COMMUNICATIONS.)

satellite in view throughout each 24-hour period. This solution is not practical for home satellite TV applications where multiple satellites, including the inclined orbit satellite, will regularly be accessed by the receiving system. Any movement of the polar mount antenna outside of the normal operational boundaries will affect the antenna's ability to properly track the other satellites in geostationary orbit.

Automated receivers and control systems are available from U.S. companies such as R.L. Drake, Merrimac Satellite, and Astroguide which receive data from the satellite receiver's AGC (Automatic Gain Control) signal level in order to obtain information on the relative signal strength of the inclined oribt satellite. If the signal level falls below an established threshold level, the system's microprocessor initiates a search routine that commands the movement of the antenna's tracking system until optimum reception has been restored. These systems also have memory circuits which will automatically return the antenna to the correct declination setting to permit normal reception of the geostationary satellites.

A more detailed description of inclined orbit satellite tracking, systems and manufacturers is contained in *The Inclined Orbit Satellite TRACKING GUIDEBOOK* published by MLE Inc. Limited copies are still available at press time.

FUTURE REGIONAL SATELLITE SYSTEMS

The satellite market in the Asia/Pacific region will be dramatically transformed during the next two years by the launch of several second generation replacement satellites as well as new regional satellite systems. What's more, all of the new satellites described below will deliver signals to Australia and New Zealand. Best of all, these new systems will provide much needed additional capacity for the region, which will allow the introduction via satellite of a dazzling array of new direct-to-home (DTH) and cable TV services.

ASIASAT 2

In 1992, AsiaSat began preparations to launch a new dual-band communications satellite called AsiaSat 2. The satellite was launched by a Chinese Long March 2E rocket in November 1995.

AsiaSat 2 carries twenty-four C-band transponders (twenty with a bandwidth of 36-MHz and four with a bandwidth of 72-MHz) and nine 54-MHz-wide Ku-band transponders. Embracing 53 countries within its footprints, AsiaSat 2 serves over 3.3 billion people or 63 percent of the world's population from the orbital position of 100.5 degrees east longitude.

The satellite's C-band footprint is designed to provide high-powered and extensive coverage over the Asia-Pacific Region, stretching from Far East Russia to Turkey and south to Australia, reaching the Indian Subcontinent, the Middle East and Eastern Europe. On C-band, the satellite transmits using powerful 55-watt amplifiers, which allow small aperture antennas to receive the signals from anywhere within the AsiaSat 2 coverage area.

AsiaSat 2's Ku-band coverage beam includes China, Hong Kong, Japan, Korea and Taiwan. The satellite's Ku-band payload will feature high-powered 115-watt TWTAs, which permit the satellite to be used for direct broadcast satellite operations within AsiaSat 2's Ku-band footprint. Plans for AsiaSat 3 have been announced, although launch date and orbital slot are not known.

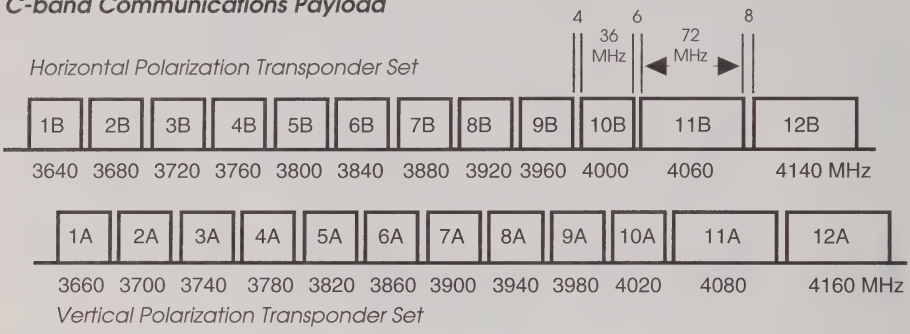
ASIASAT 2 TV AND RADIO PROGRAM SERVICE PROVIDERS

In 1994, STAR TV announced that it had acquired a total of eight C-band transponders on the new AsiaSat 2 satellite. STAR TV intends to use a new digital video compression system known as "DigiSTAR" to transmit as many as fifty pay TV services via AsiaSat 2. Antennas as small as one meter in diameter will be able to receive all of these new channels.

At the time of writing a total of seven different clusters of program services are planned, with each cluster featuring

FIG. 13-1. ASIASAT 2 DOWNLINK FREQUENCY PLAN

C-band Communications Payload



Ku-band Communications Payload

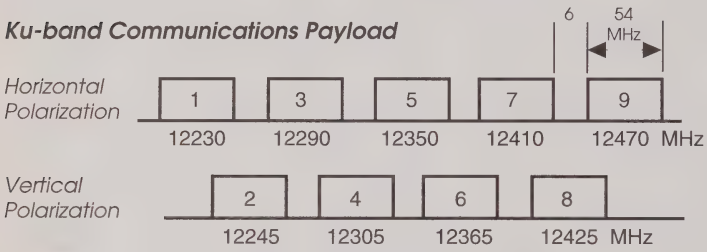
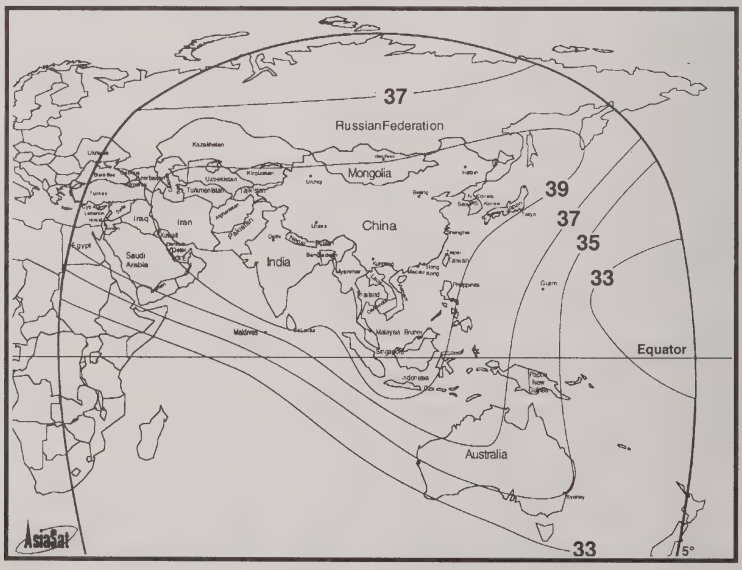


FIG. 13-2. ASIASAT 2 C-BAND COVERAGE BEAM. (COURTESY ASIASAT.)



a major regional language. To facilitate access to the various regional markets, STAR TV has been working on joint venture projects in Indonesia, the Philippines, Malaysia, Singapore, Thailand and the People's Republic of China. The first of these new joint venture agreements, which was announced in 1995, is between STAR TV and PT Matahari Lintas Cakrawala—Indonesia's sole pay TV licensee and operator of the Indovision DTH service on the Palapa satellite system.

PT Matahari Lintas will distribute STAR TV's new digital "DigiSTAR" channels in Indonesia. An initial package of fifteen channels designed specifically for audiences in Indonesia is envisioned, including movie services, popular music video channels, sports, news and entertainment programming from Asia and around the world. The Indonesian company also will co-produce with STAR TV local-language TV programming beginning in late 1996 for the new STAR services in Indonesia.

Portugal-based Marconi Global Communcations has acquired one 36-MHz C-band transponder on Asiasat2. The capacity is being used to broadcast RTPi, the Portuguese International Television Channel and Antena 1, a Portuguese radio program of Radiodifusao Portuguesa. TV programming will include more than 80 live football matches and 90 feature films per year as well as news, magazines, documentaries, quiz shows and children programs. The use of AsiaSat 2 will enable RPTi to reach a vast market of Portuguese-speaking communities including 70,000 in Australia, 160,000 in Japan, and Macau, Timor, Goa and Malacca.

German Deutche Welle Radio and TV also has acquired one 26-MHz C-band transponder on Asiasat2. This capacity is being used to transmit a 'bouquet' of national European TV and radio programs throughout the Asia/Pacific region in an open key DVB compliant MPEG2 digital format.

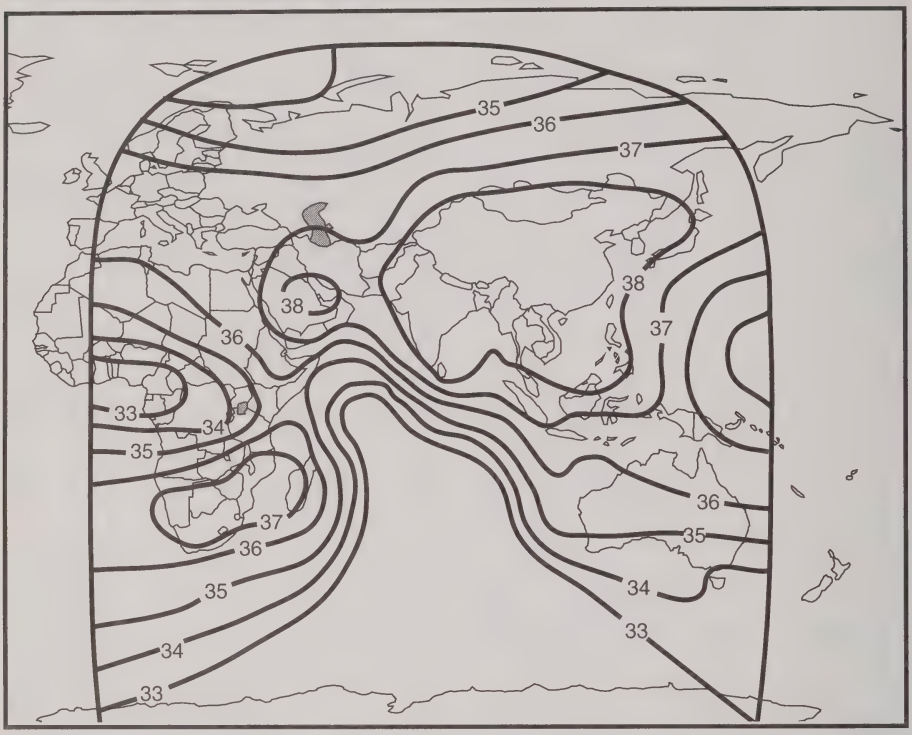
Associated Press Television (APTV) and Worldwide Television News (WTN) have each acquired 9 MHz segments of capacity on Asiasat2 for the distribution of television news services on a daily basis. Both organizations intend to use a digitally compressed transmission format. Based in London, APTV operates through 93 international bureaus in 67 countries and employs more than 130 full time TV professionals around the world. WTN is an international television news agency with headquarters in London that is owned by the U.S. ABC television network (80%) and ITN of the United Kingdom (20%). WTN, which has 118 television news bureaus around the world, currently uses a variety of satellites to relay live and taped news feeds to more than one thousand broadcasters and cable networks around the world.

The British Broadcasting Corporation plans to use AsiaSat2 for a digital Global Distribution System of up to 15 stereo radio services in some 13 languages, for distribution to shortwave radio transmitter sites and re-broadcasters throughout the region.

Australian sports programmer Sky Channel plans to introduce a digital MPEG2 service from Asiasat2 commencing in September 1996.

Other AsiaSat 2 users include the Mandarin language service CCTV-1 from Bejing, the Ministry of Radio, Film, and Television of China as well as telecommunications users such as Pacific Cen-

FIG. 13-4. APSTAR 2R C-BAND COVERAGE BEAM, EIRP CONTOUR VALUES IN DBW.



APSTAR-IIR DOWNLINK PARAMETERS

C-band Downlink Parameters		Ku-band Downlink Parameters	
No. of Trs:	28, 36 MHz for 27 transponders and 30 MHz for 1 transponder	No. of Trs:	16, eight on China Beam #1 and eight on China Beam #2
Freq. Range:	3.625 to 4.200 GHz	Freq. Range:	12.25 to 12.75 GHz
EIRP:	32.1 to 39.1 dBW	EIRP:	China Beam #1: 42.6 - 53.6 dBW China Beam #2: 42.8 - 56.8 dBW
Coverage:	Asia, Australia, Eastern Europe and Africa	Coverage:	Mainland China, Taiwan, Hong Kong and Maco
Power:	60 watts per transponder	Power:	110 watts per transponder

FIG. 13-5. APSTAR 2R DOWNLINK SPECIFICATIONS

tury Group.

APSTAR 2R

In early 1997, Hong Kong based APT Satellite Co. Ltd. plans to launch a replacement satellite for the Apstar 2 spacecraft which was lost at launch in early 1995. The new satellite, which primarily will be used for television broadcasting, will carry twenty-eight C-band transponders and sixteen Ku-band transponders. On C-band, the satellite will transmit using 60-watt amplifiers, while the Ku-band payload will feature 110-watt transponders. The satellite's C-band coverage beam will extend from eastern Europe, Africa and the Middle East to northeast Asia and as far south as the Australian continent. The satellite will be located at 77 degrees east longitude over the Indian Ocean.

Several international programmers already have collectively booked sixteen transponders on the new satellite. CNN International, ESPN International, Discover Communications, Viacom Networks, Time Warner and TVB International have plans to adopt common en-

FIG. 13-6. PALAPA C STANDARD BEAM (1) COVERAGE AREA.. (COURTESY SATELINDO.)

cryption and compression standards to permit the use of common sales and marketing strategies for their DTH and cable TV distribution services.

PALAPA C

Indonesia has begun replacing its fleet of Palapa B satellites with new generation Palapa C satellites. The new Palapa C2M replaced an ailing C1 at 113 degrees east longitude in June 1996. Each Palapa C satellite carries thirty C-band transponders, each with a bandwidth of 36 MHz, and four Ku-band transponders, each with a bandwidth of 72 MHz. Palapa C satellites not only transmit using the conventional C-band frequency spectrum of 3.7 to 4.2 GHz but also newly available C-band frequencies ranging from 3.4 to 3.68 GHz. The Ku-band frequency spectrum to be used by these new satellites ranges from 10.95 to 11.7 GHz.

The new dual band Palapa C1 and C2 spacecraft feature two "standard" contoured C-band beams that will provide excellent coverage throughout an area ranging from Southeast Asia to as far south as eastern Australia and New Zealand. As many as twenty-four of the satellite's thirty transponders will operate through one of the two available standard beams (see pages 174 and 175). A minimum of six additional C-band transponders will connect to an

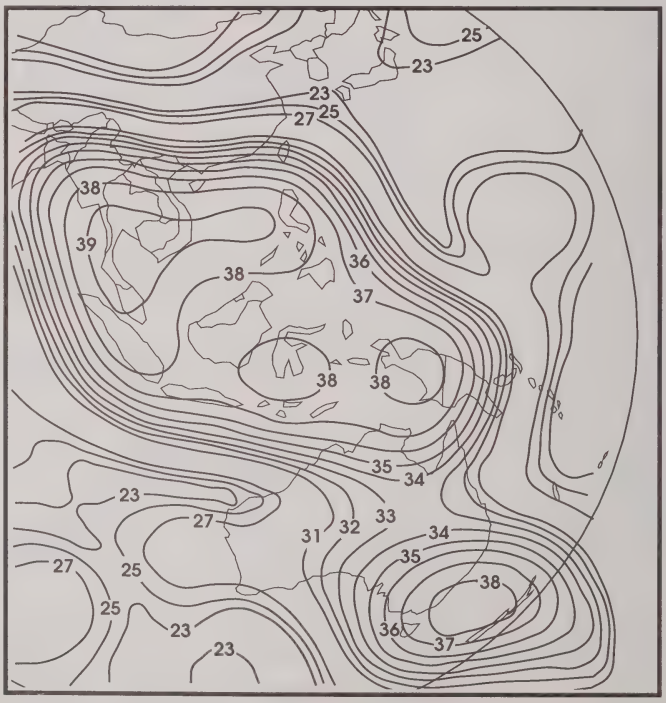


FIG. 13-7. PALAPA C PREDICTED STANDARD BEAM (2) COVERAGE AREA. (COURTESY SATELINDO.)

"extended" C-band beam which will provide excellent coverage of the Asian continent from Japan and Korea in the east, to India in the west and Malaysia in the south. The extended C-band beam will not be receivable in either Australia or New Zealand.

Each satellite's two Ku-band beams will cover an area that includes Guam, Hong Kong, Japan, Macau, Singapore, Malaysia, Taiwan, and Thailand. Neither Australia or New Zealand are included in any of the spacecraft's Ku-band coverage beams.

Many of the regional programmers that were using the Palapa B2P satellite located at 113 degrees east longitude have migrated to the new Palapa C satellites to increase their coverage of the Asia Pacific region.

PAS-4

PAS-4 is a dual-band satellite built for PanAmSat, the world's first privately-owned international satellite operator. PAS-4 carries sixteen C-band and twenty-four Ku-band satellite transponders. PAS-4 was launched in August of 1995 to an orbital assignment of 68.5 degrees east longitude over the Indian Ocean.

Twelve C-band transponders use 34 watt amplifiers which have a bandwidth of 54 MHz, while four transponders have a bandwidth of 64 MHz. On Ku-band, the spacecraft features eight 54 MHz-wide transponders and sixteen 27 MHz-wide transponders. All of the Ku-band transponders feed into powerful 63-watt amplifiers.

The PAS-4 satellite's C-band transponders connect to one of three regional beams covering the African continent (1), India and the Middle East (2), and an

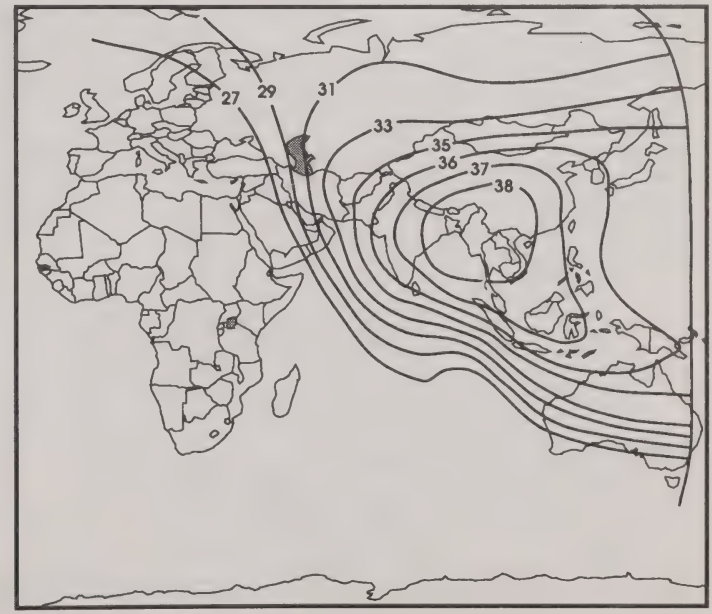


FIG. 13-8. THE PAS-4 C-BAND ASIA COVERAGE BEAM WILL DELIVER SIGNAL INTO THE NORTHERN HALF OF AUSTRALIA..

area stretching from eastern Asia to northwestern Australia, The satellite's Ku-band transponders connect to one of six regional beams covering southern Africa (1), India (2), the Arabian peninsula (3), eastern Europe (4 and 5), and northeast Asia (6). The Ku-band transmissions from PAS-4 will not be receivable in Australia.

EXPRESS

In 1995, The Russian Space Agency deployed the first in a new series of "Express" communications satellites to an orbital assignment over the Atlantic Ocean Region. Russia eventually intends to deploy several Express satellites over the Indian and Pacific Oceans to replace older Gorizont and Raduga satellites.

Express satellites each carry ten C-band and two Ku-band transponders. On C-band, the Express satellites offer a wide array of beam coverages, including global, northern hemispheric, zone and spot beams. Both the zone and spot beams are fully steerable for coverage of any land mass visible from the satellite's assigned orbital location. Previously announced Express orbital assignments within the Asia/Pacific region include 80, 90, 96.5, 103, and 140 degrees east longitude.

INTELSAT VIII SERIES SATELLITES

The international INTELSAT organization is constructing a new series of INTELSAT VIII satellites, several of which will be assigned to operate in the Asia/Pacific Region. The first INTELSAT VIII satellite is scheduled for launch in 1996.

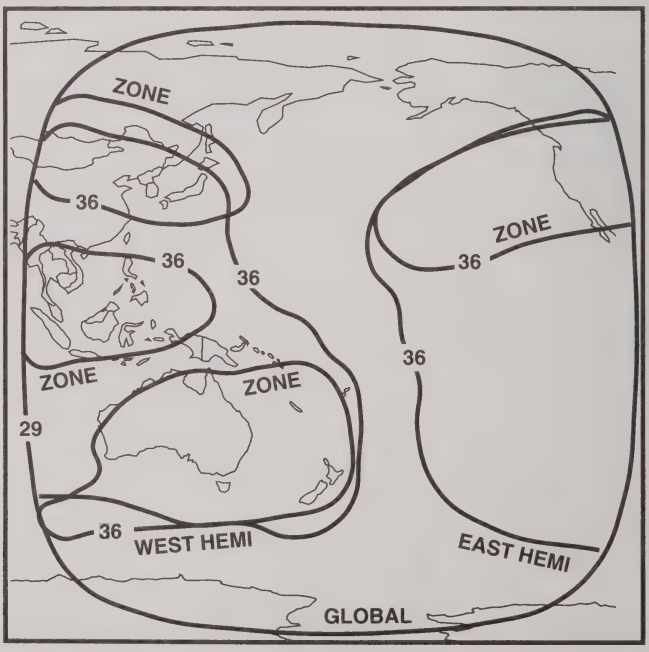


FIG. 13-9. SCHEDULED FOR LAUNCH IN 1996, INTELSAT 801 WILL BE LOCATED INITIALLY AT 174 DEGREES EAST LONGITUDE OVER THE PACIFIC OCEAN. THE LARGE OVAL DENOTING THE GLOBAL BEAM WILL ACHIEVE A MINIMUM EIRP OF 29 DBW, WHILE THE SMALLER HEMISPHERIC AND ZONE BEAMS WILL PRODUCED A NOMINAL EIRP OF 36 DBW.

INTELSAT VIII will carry thirty six C-band transponders, thirty of which will be capable of generating a nominal 36 dBW over each of its C-band hemispheric and zone beams, the highest power levels ever achieved by an INTELSAT satellite on C-band . The additional six C-band transponders will connect to a global beam capable of achieving a minimum of 29 dBW throughout each satellite's global coverage area.

INTELSAT VIII spacecraft also will carry as many as six Ku-band transponders. The INTELSAT 805 satellite, which will be located at an orbital assignment of 110 degrees east longitude, is being specially constructed to serve INTELSAT's new Asian Land Mass Region. INTELSAT 805 will be jointly owned by INTELSAT and the People's Republic of China following its expected launch in 1997.

INTELSAT 805 will feature twenty-eight C-band transponders and three Ku-band transponders. To optimally respond to regional market demands, INTELSAT 805 also will feature the ability to use either linear or circular polarization for its C-band transmissions. The satellite's C-band coverage area ranges from eastern Europe and the Arabian peninsula in the west to Japan, Australia and portions of New Zealand in the east. Ku-band coverage will be limited to China, Hong Kong, Japan, Korea, Mongolia, and Taiwan.

JCSAT 3

Tokyo-based Japan Satellite Systems Inc. launched its new dual-band satellite called JCSat 3 to an orbital assignment of 124 degrees east longitude in August of 1995. JCSat 3 provides four primary coverage beams: Ku-band beams centered over mainland Japan (1), northeast Asia (2), and Australia/New Zealand (3); and a C-band beam that stretches from Japan through southeast Asia to

FIG. 13-10. INTELSAT 805 IS A SPECIALLY MODIFIED VERSION OF THE INTELSAT VIII THAT WILL BE DEDICATED TO SERVING THE ASIAN LAND MASS REGION. THE PROJECTED C-BAND COVERAGE BEAM IS SHOWN AT THE RIGHT.

FIG. 13-11 & FIG. 13-12. JCSAT 3 C-BAND & KU-BAND COVERAGE BEAMS.

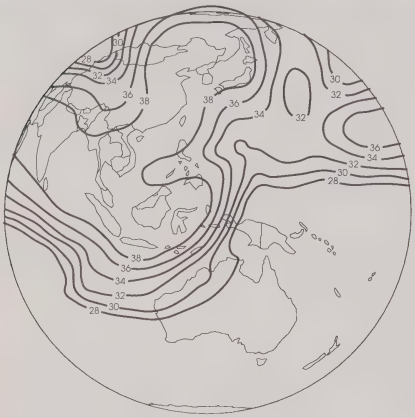


FIG. 13-13. ARTIST RENDITION OF THE JCSAT SATELLITE. (COURTESY HUGHES AIRCRAFT.)

most of mainland China and India. Additional spot coverage of Hawaii, Singapore, Hong Kong, Taiwan and the Korean peninsula also will be available. A total of twelve C-band and twenty-eight Ku-band transponders will be carried by this spacecraft.

JCSat4, a new satellite similar in design to JCSat3 is planned for launch early in 1997.

THAICOM 3 & THAICOM 4

Shinawatra Satellite Public Co., Ltd., operator of the Thaicom 1 and 2 satellites for the Kingdom of Thailand, has announced the construction of two additional satellites, Thaicom 3 and 4, which will be used to provide regional satellite communications services throughout the Asia/Pacific region. Both satellites will be manufactured by Aerospatiale of France. Thaicom 3 is

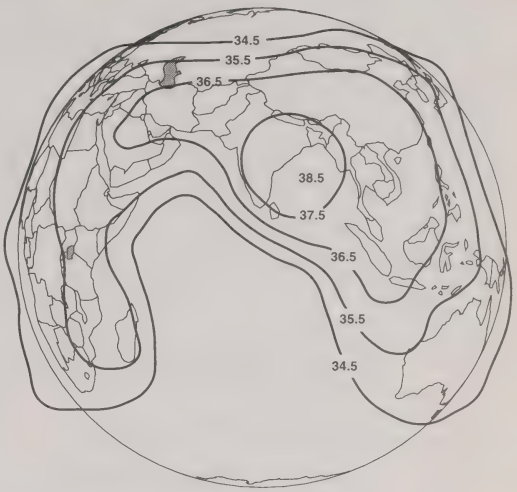


FIG. 13-14. SET FOR LAUNCH IN 1997, THE NEW THAICOM 3 SATELLITE WILL FEATURE A GLOBAL BEAM THAT INCLUDES COVERAGE OF AUSTRALIA.

scheduled for a late-1996 launch to an orbital location over the Indian Ocean.

Thaicom 3 and 4 will be three-axis stabilized satellites with a much larger capacity than the current spin stabilized Thaicom 1 and 2 spacecraft. Each new satellite will carry twenty-four medium-power C-band transponders and twelve high-power Ku-band transponders.

Thaicom 3 will provide C-band coverage that will span four continents: Asia, Europe, Australia and Africa. Ku-band coverage will include a high-powered beam illuminating Southeast Asia, and a steerable beam that can be used to provide direct-to-home (DTH) TV transmissions to other countries such as India, where Shinawatra is working to establish a consortium for the introduction of a digital DTH service on Thaicom 3. According to Shinawatra, Thaicom 3 will be able to provide 60 to 70 digital TV channels to 60cm receiving antennas in most major cities in India.

FIG. 13-15. MEASAT-1. (COURTESY HUGHES AIRCRAFT.)

THE MEASAT SATELLITE SYSTEM

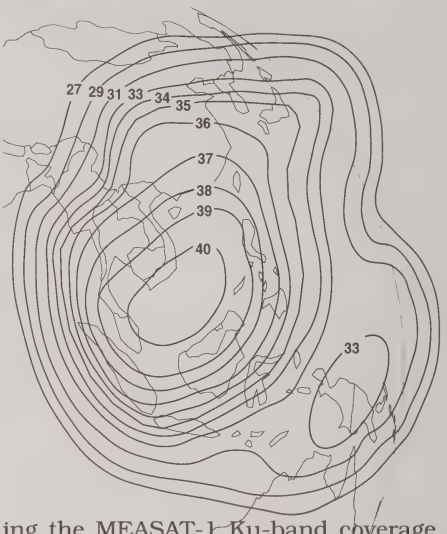
Binariang Sdn Bhd of Kuala Lumpur, a joint venture between local Malaysian shareholders and American "baby bell," USWEST, has received government authorization to construct, launch and operate the Malaysian East Asia Satellite (MEASAT) system. MEASAT-1 was launched by Arianespace on January 12th 1996 to 91.5 degrees east longitude. A second spacecraft, MEASAT-2, is scheduled to be launched by Arianespace in October of 1996. Both satellites are being manufactured by U.S.-based Hughes Aircraft.

MEASAT-1 will carry twelve C-band and five Ku-band (10.95 to 11.2 GHz and 12.25 to 12.37 GHz spectrums) transponders. The satellite's C-band footprint will provide high power coverage into most of East Asia, including Northern Australia, Brunei, Hong Kong, Kampuchea, Laos, Malaysia, Myanmar, Philippines, Singapore, Taiwan, Thailand, Vietnam and parts of southern China.

The MEASAT-1 satellite's high-power Ku-band beam is focused onto Malaysia, where it will be used to transmit a package of digitally-compressed TV channels to antennas as small as 50 cm in diameter. The spacecraft also has the option of switching beam coverage of selected Ku-band transponders to also cover the Philippines and India by ground command.

MEASAT-2 has been designed to provide back-up capacity for MEASAT-1 as well as deliver additional capacity and expanded regional coverage. MEASAT-2 will carry six C-band transponders covering the East Asian region and ten Ku-band transponders capable of duplicating the MEASAT-1 Ku-band coverage, with the addition of new spot beams centered over Queensland, Australia; Vietnam; and Indonesia.

FIG. 13-15. MEASAT-1 C-BAND COVERAGE BEAM.



PHILIPPINE SATELLITE PROJECT

The Mabuhay Philippines Satellite Corporation has signed a contract with satellite manufacturer Space Systems/Loral governing the construction of a regional communications satellite with thirty C-band and twenty-four Ku-band transponders. The spacecraft is scheduled to be launched by the China Great Wall Industry Corporation in December of 1996. The orbital assignment for this new regional satellite was not identified, but Mabuhay chairman Antonio Cojuangco has announced that the orbital position for the new spacecraft was obtained through Indonesian satellite company Pasific Satelit Nusantara, a participant in the Philippine satellite project.

APPENDIX A
INTERPRETING SATELLITE FOOTPRINTS

There are many factors which help to determine the dish size for any given satellite TV system *receiving analog video signals:* the satellite frequency being received, the elevation angle of the dish for a given satellite, the amount of free space loss between the satellite and the receiving antenna, threshold C/NR of the satellite receiver, LNB noise temperature, and the bandwidth of the satellite receiver. Whew! The following chart assumes average values (†) for some of the less significant factors while listing several combinations of C- and Ku-band LNB noise temperatures and antenna sizes. For those satellite TV systems *receiving digitally compressed video signals*, the required antenna size may be even smaller; this will depend on the number of video services carried by any given satellite transponder, the data transmission rate selected by the satellite TV service provider and other related factors.

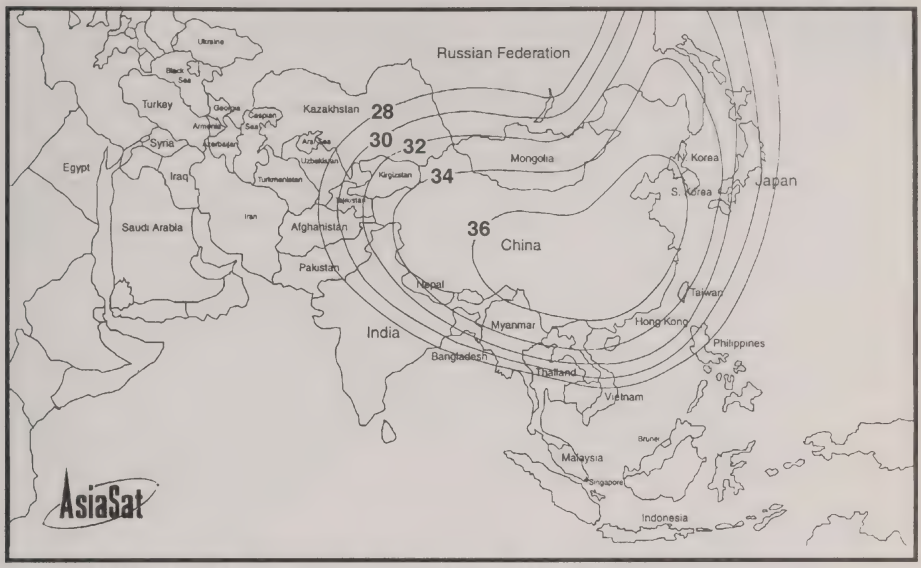
C/Ku-band Satellite TV System Parameters Chart

Satellite EIRP	C-band Systems 90 K.	40 K. LNB	Ku-band Systems 220 K.	120 K. LNB
50 dBW			2 ft.	1.5 ft.
48 dBW			3 ft.	2 ft.
46 dBW			4 ft.	3 ft.
44 dBW			4.5 ft.	3.5 ft
42 dBW			5 ft.	4 ft.
40 dBW	5 ft.	4 ft.	5.5 ft.	4.5 ft.
38 dBW	6 ft.	5 ft.	6 ft.	5 ft.
37 dBW	7 ft.	6 ft.	7 ft.	6 ft.
36 dBW	8 ft.	7 ft.	8 ft.	7 ft.
35 dBW	9 ft.	8 ft.	9 ft.	8 ft.
34 dBW	10 ft.	8.5 ft.	10 ft.	9 ft.
33 dBW	11 ft.	9 ft.	11 ft.	10 ft.
32 dBW	12 ft.	10 ft.	12 ft.	11 ft.
31 dBW	13 ft.	11 ft.	13 ft.	12 ft.
30 dBW	15 ft.	12 ft.	15 ft.	13 ft.
29 dBW	16 ft.	13 ft.	16 ft.	14 ft.
28 dBW	20 ft.	15 ft.	20 ft.	17.5 ft.
27 dBW	22 ft.	18 ft.	22 ft.	20 ft.
26 dBW	24 ft.	20 ft.	24 ft.	22 ft.

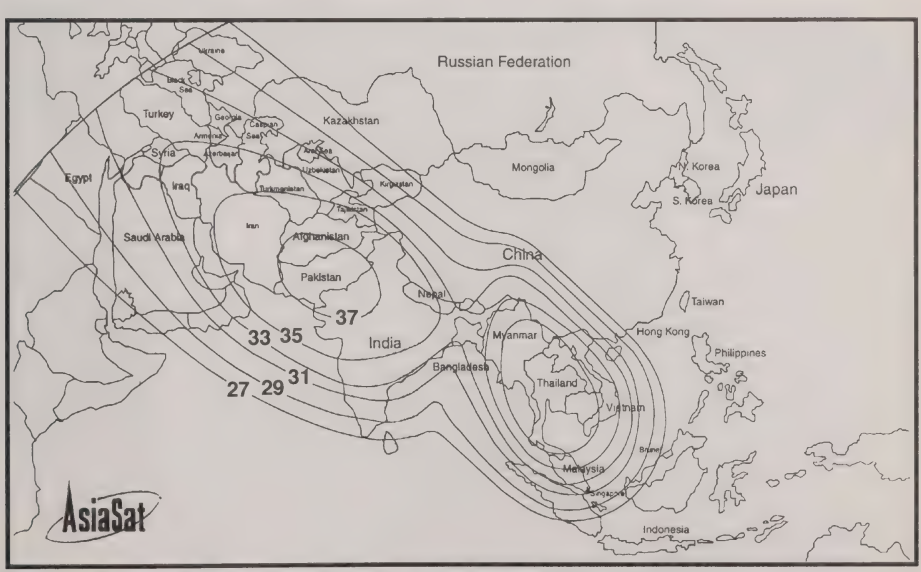
(†) With dish elevation above 20 degrees, 30 MHz receiver bandwidth, 8 dB C/NR receiver threshold, and 55 percent antenna efficiency. Dish elevations below 10 degrees will require larger antennas than the sizes listed above.

ASIASAT 1 EIRP AND AZ/EL COORDINATES

Country	EIRP Range	Major City	EIRP	TVRO	Elevation/Azimuth	
China	32~36 dBW	Shanghai	36 dBW	1.8m	50	209
Japan	30~34 dBW	Tokyo	30 dBW	3.7m	35	229
South Korea	35~35 dBW	Seoul	36 dBW	2.4m	42	213
North Korea	35~35 dBW	Pyongyang	36 dBW	2.4m	40	213
Mongolia	30~34 dBW	Ulan Bator	32 dBW	3m	35	182
Georgia (CIS)		Tbilisi	32 dBW	3m	13	110
Russia (CIS)		Vladivostok	34 dBW	2.4m	33.7	216
		Irkutsk	30 dBW	3.7m	30.2	178
		Astrakhan	30 dBW	3.7m	12.3	114
		Rostov	30 dBW	4.5m	7.6	108
Ukraine (CIS)		Sevastopol	30 dBW	4.5m	4.1	103
Armenia (CIS)		Yerevan	32 dBW	3.5m	13.3	110
Azerbaijan (CIS)		Baku	33 dBW	2.4m	17.1	114
Turkmen (CIS)		Ashkhabad	35 dBW	2.4m	23.5	121
Uzbek (CIS)		Tahkent	34 dBW	3m	30	132
Tadghik (CIS)		Dushanbe	35 dBW	2.4m	31.4	130
Kirgiz (CIS)		Osh	33 dBW	3m	32.5	135
Taiwan	33~35 dBW	Taipei	35 dBW	2.4m	55	215
Hong Kong	35 dBW	Hong Kong	35 dBW	2.4m	62	202
Philippines	Up to 31 dBW	Manila	28 dBW	5m	65	227
Vietnam	34~36 dBW	Hanoi	35 dBW	3m	65	180
Kampuchea	36~37 dBW	Phnom Penh	37 dBW	1.8m	76	177
Laos	36~37 dBW	Vientiane	37 dBW	1.8m	69	171
Thailand	35~37 dBW	Bangkok	37 dBW	1.8m	73	160
Malaysia	Up to 35 dBW	Kuala Lumpur	35 dBW	2.4m	84	127
Singapore	32 dBW	Singapore	32 dBW	3m	88	130
Indonesia	Up to 33 dBW	Medan	31 dBW	3.5m	81	115
Myanmar	33~37 dBW	Rangoon	32 dBW	3m	68	150
Bangladesh	33~35 dBW	Dhaka	33 dBW	3m	58	146
India	23~37dBW	New Delhi	37 dBW	1.8m	45	132
Bhutan	33~34 dBW	Thimbu	33 dBW	3m	53	149
Nepal	33~35 dBW	Kathmandu	34 dBW	3m	52	146
Pakistan	35~37 dBW	Karachi	37 dBW	1.8m	40	119
Afghanistan	35~37 dBW	Kabul	37 dBW	1.8m	34	128



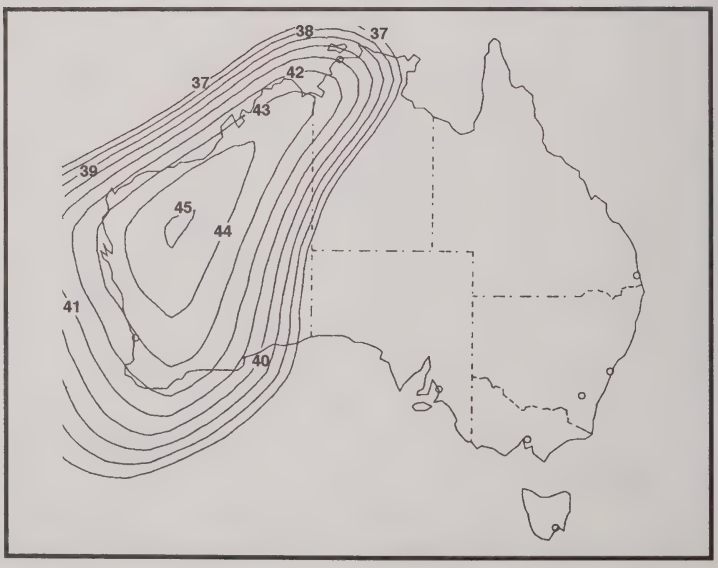
ASIASAT 1 NORTHERN BEAM COVERAGE FROM 105.5 DEGREES EAST LONGITUDE. (COURTESY ASIASAT.)



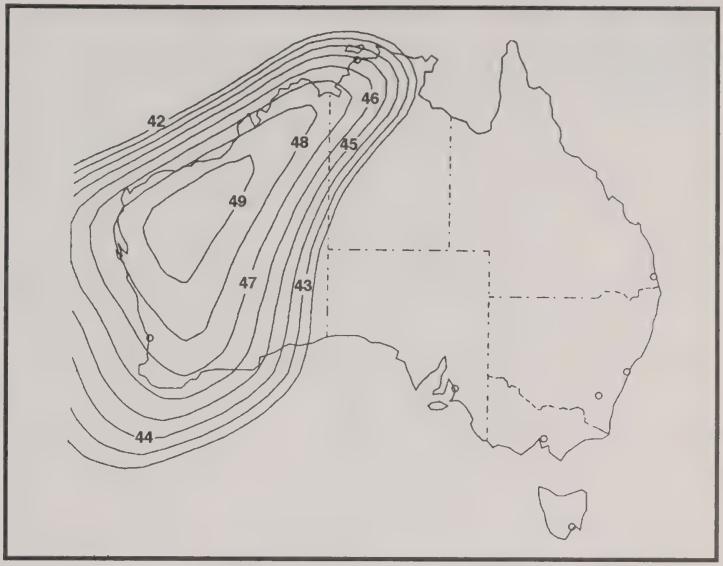
ASIASAT 1 SOUTHERN BEAM COVERAGE FROM 105.5 DEGREES EAST LONGITUDE. (COURTESY ASIASAT.)

OPTUS B NATIONAL BEAM. (COURTESY OPTUS COMMUNICATIONS.)

OPTUS A WEST AUSTRALIA (LOW POWER) BEAM. (COURTESY OPTUS COMMUNICATIONS.)



OPTUS A WEST AUSTRALIA (HIGH POWER) BEAM. (COURTESY OPTUS COMMUNICATIONS.)



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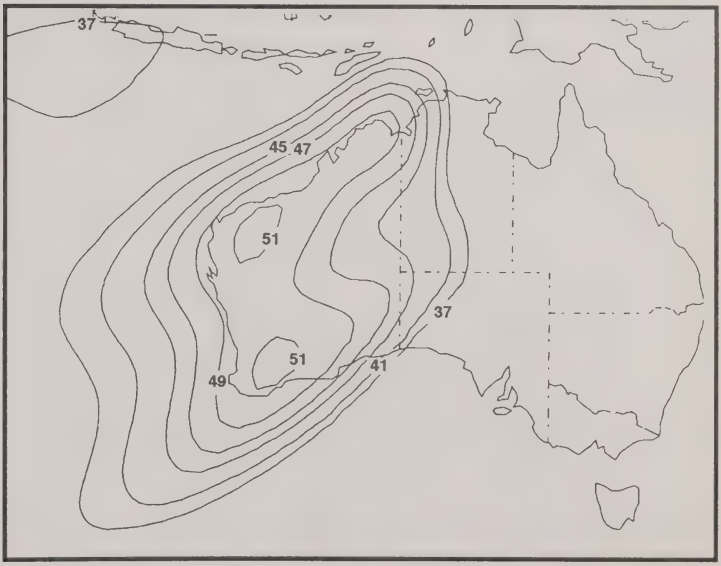

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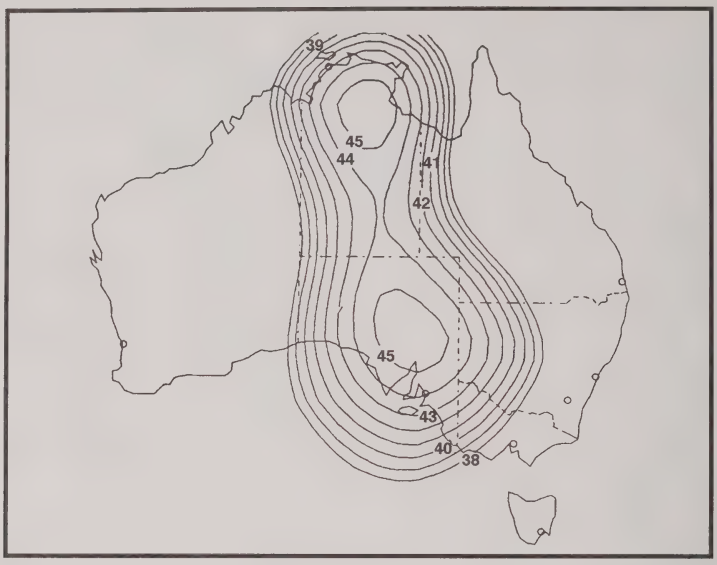

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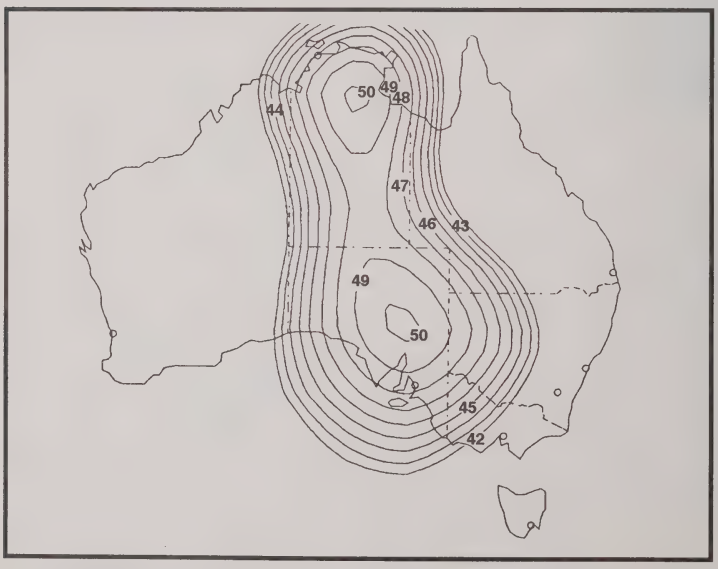

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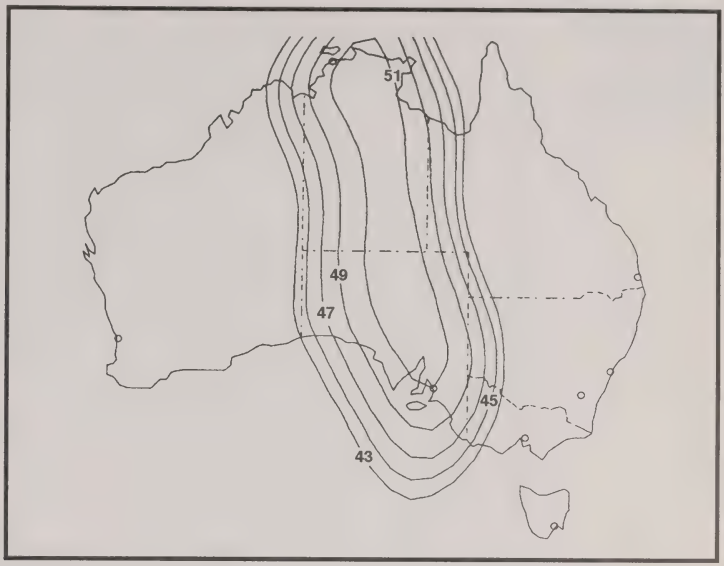

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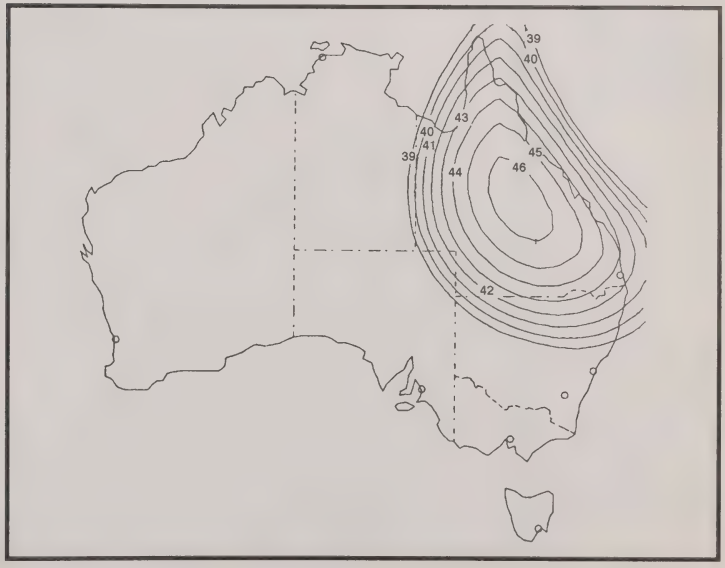

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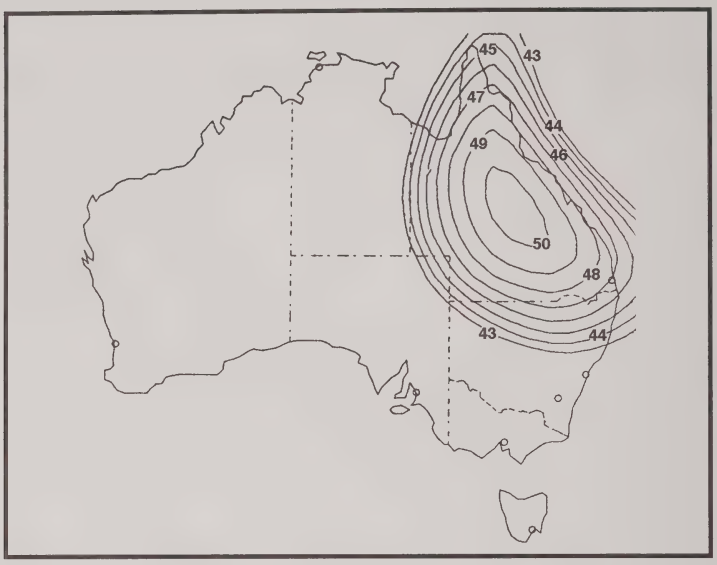

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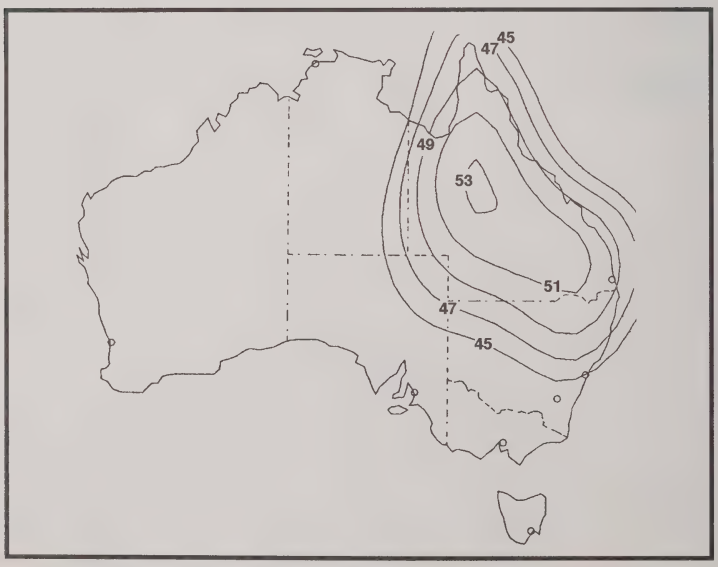

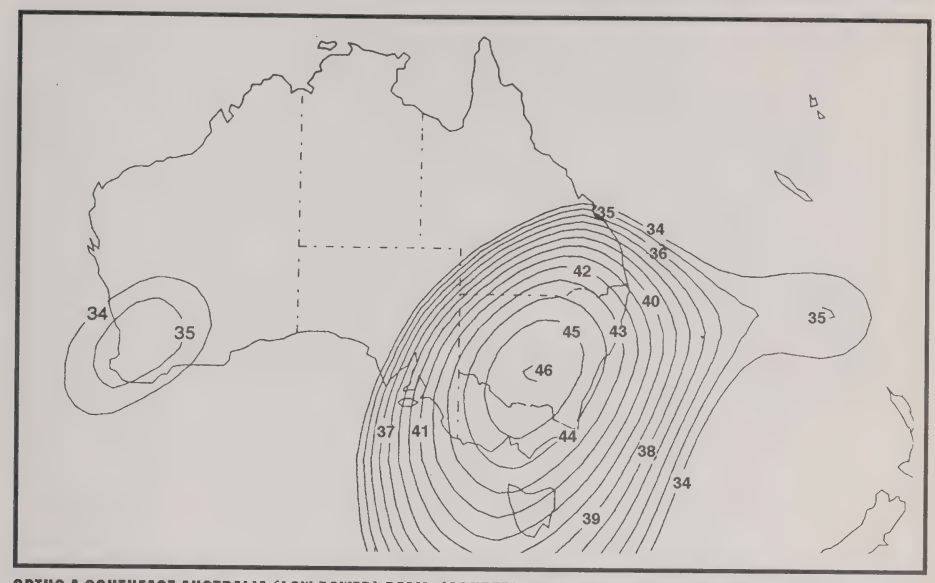

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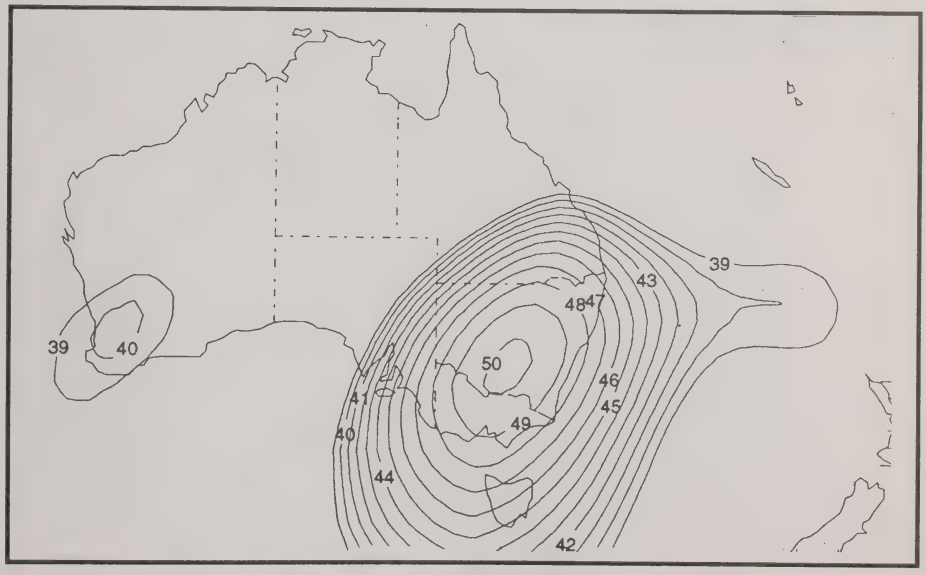

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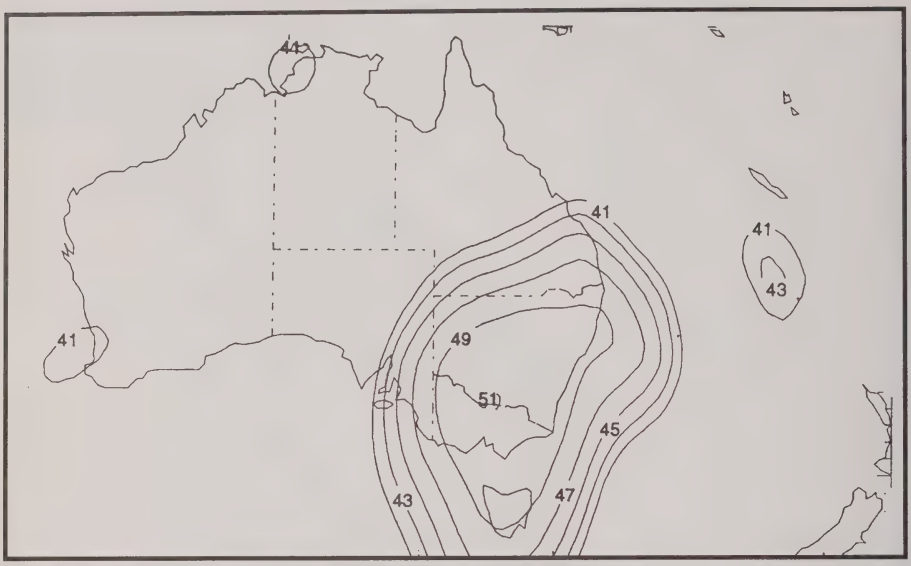

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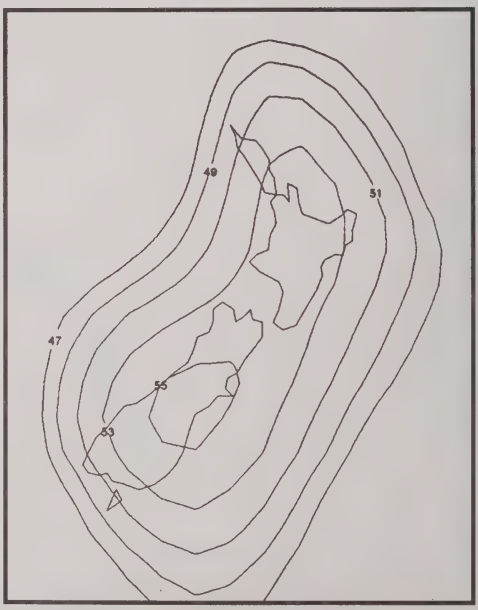
OPTUS B NEW ZEALAND BEAM. (COURTESY OPTUS COMMUNICATIONS.)



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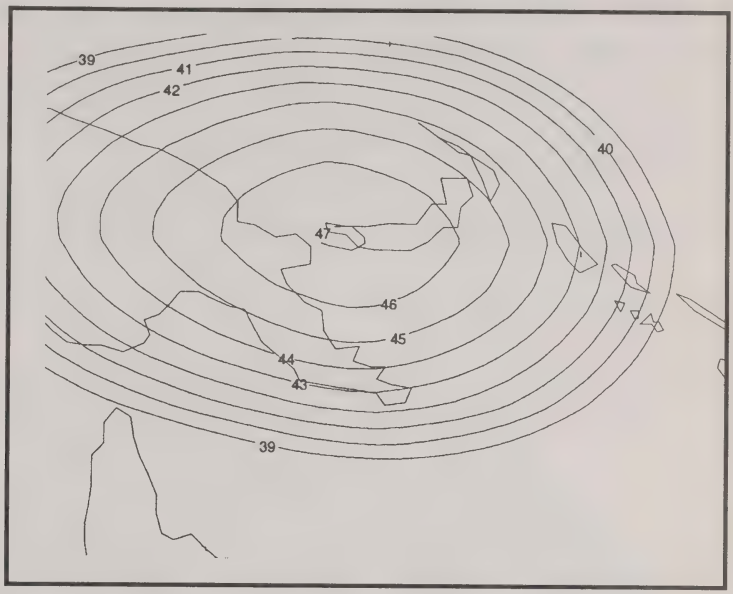

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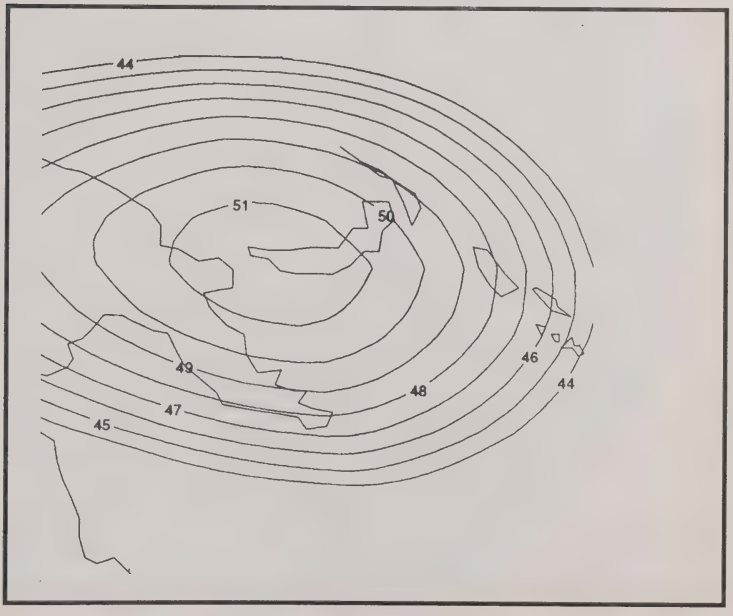
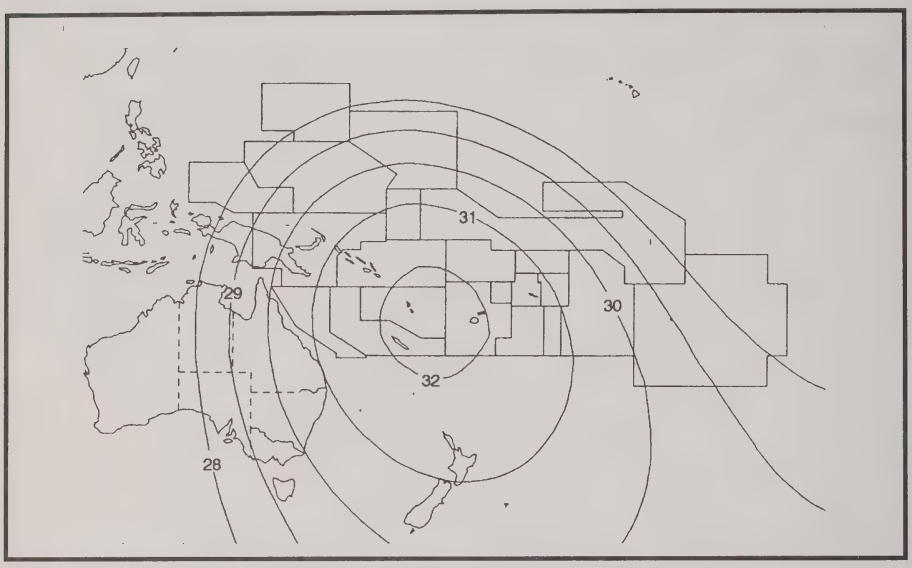
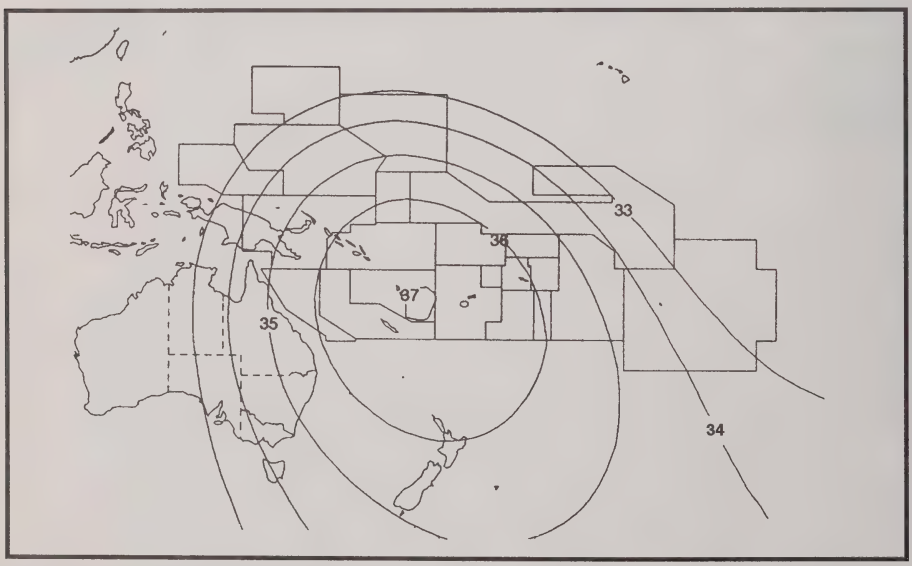




OPTUS A SOUTH WEST PACIFIC (LOW POWER) BEAM. (COURTESY OPTUS COMMUNICATIONS.)



OPTUS A SOUTH WEST PACIFIC (HIGH POWER) BEAM. (COURTESY OPTUS COMMUNICATIONS.)

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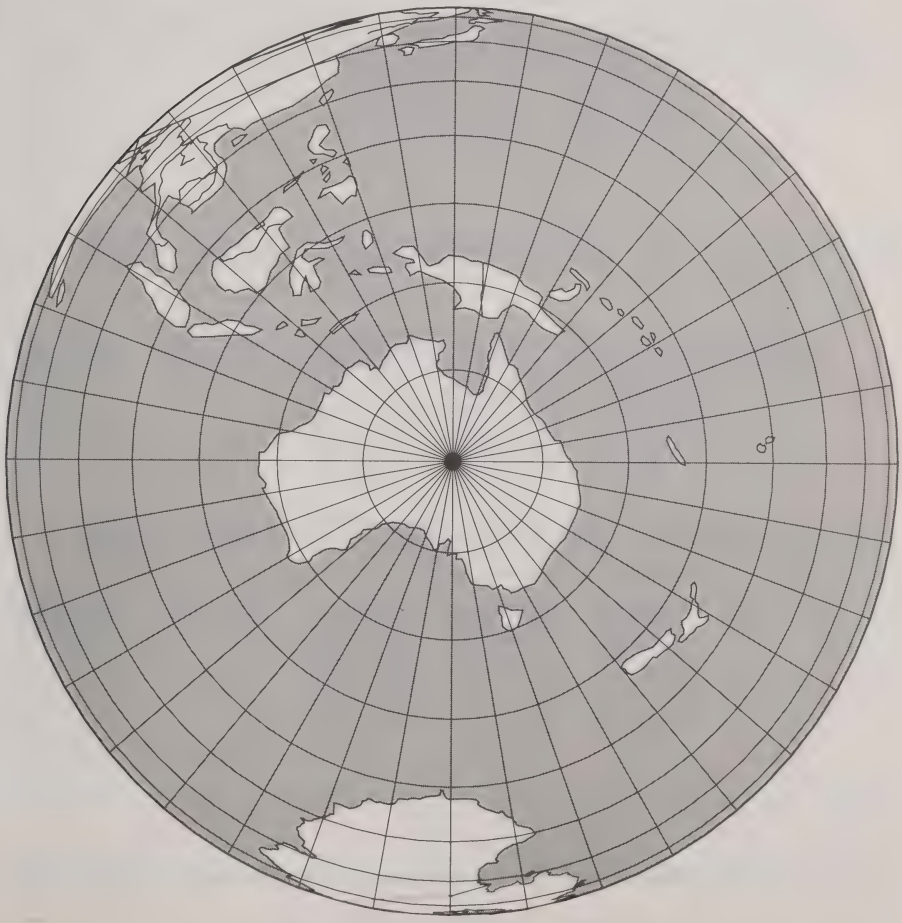
HOME SATELLITE TV PROGRAM CHARTS FOR AUSTRALIA, NEW ZEALAND & THE PACIFIC RIM

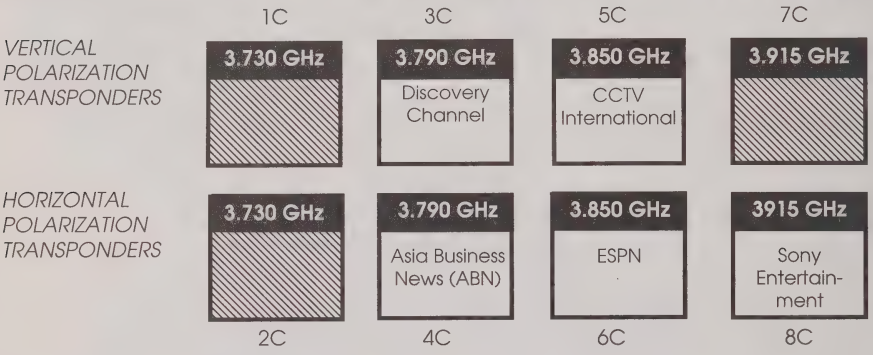
Australia & New Zealand Edition

C Band pages 194-207

Ku·Band pages 208-209

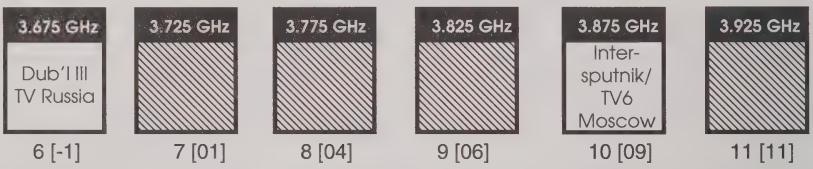


PAS-4 68.5 DEGREES EAST LONGITUDE



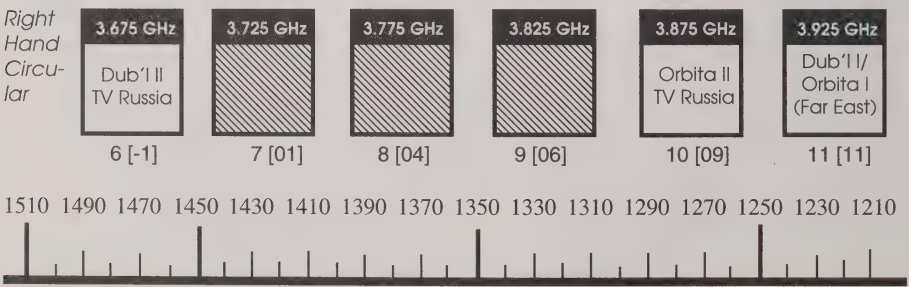
STATSIONAR-13 80 DEGREES EAST LONGITUDE

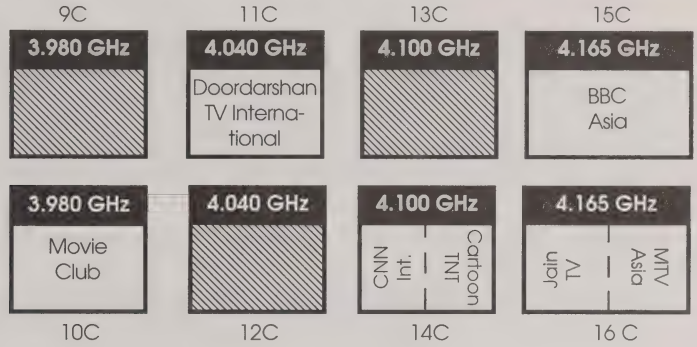
(All currently active transponders transmit using Right Hand Circular Polarization.)



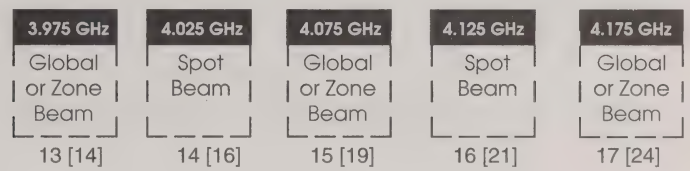
STATSIONAR-6 90 DEGREES EAST LONGITUDE

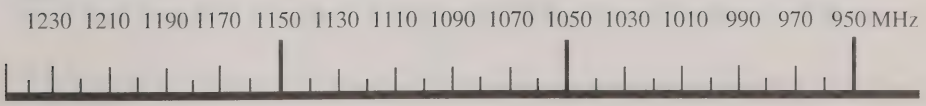
(All currently active transponders transmit using Right Hand Circular Polarization.)

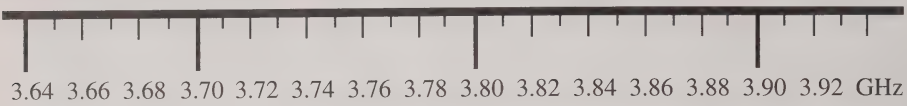




(Note: Future Statsionar "Express" class satellites serving the Asia/Pacific Region will carry the five additional C-band transponders illustrated below.)

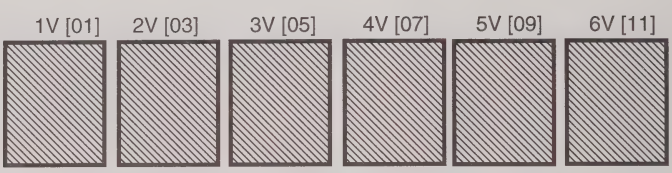






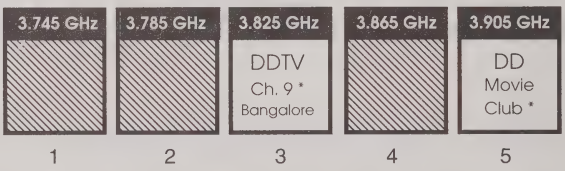
MEASAT 1 91.5 DEGREES EAST LONGITUDE

Vertical Polarization Transponders

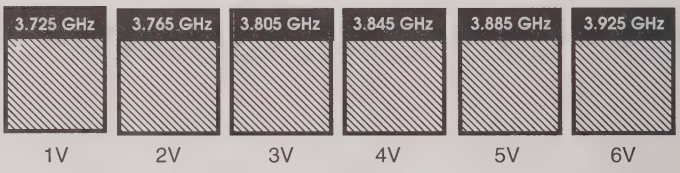


INSAT 2-B & INSAT 2-C 93.5 DEGREES EAST LONGITUDE

Horizontal Polarization

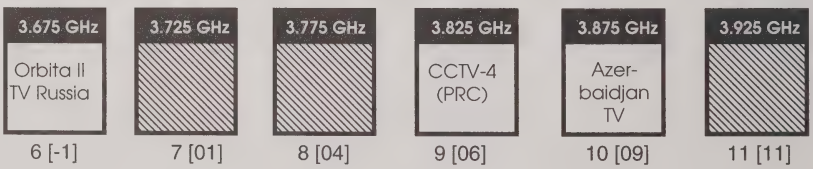


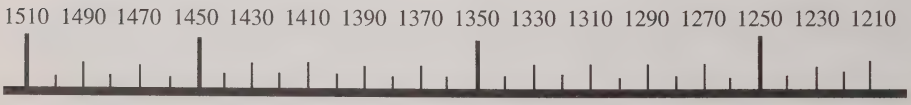
Vertical Polarization



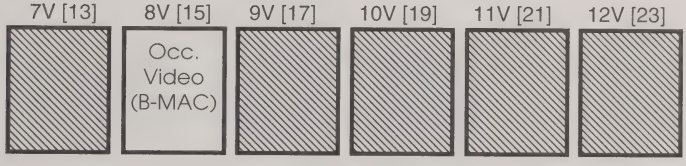
STATSIONAR-14 96.5 DEGREES EAST LONGITUDE

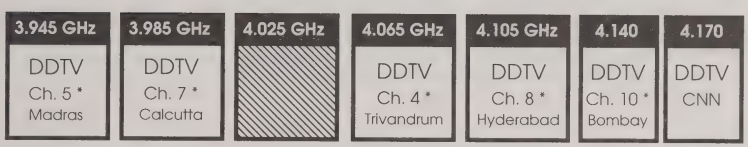
Right Hand Circular

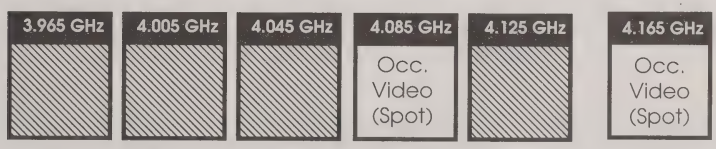




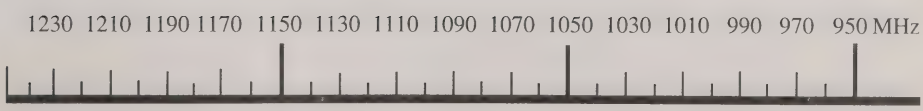
3.92 3.94 3.96 3.98 4.00 4.02 4.04 4.06 4.08 4.10 4.12 4.14 4.16 4.18 4.2 GHz





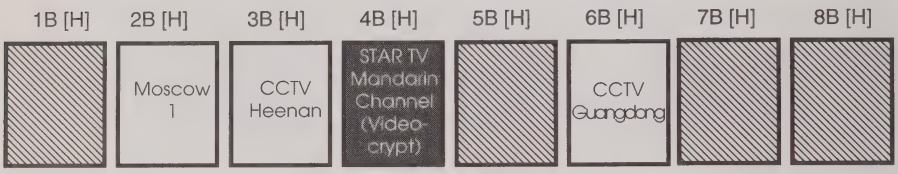


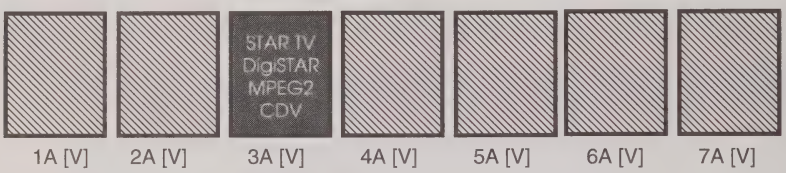
* DOORDARSHAN TV (INDIA)



1230 1210 1190 1170 1150 1130 1110 1090 1070 1050 1030 1010 990 970 950 MHz

ASIASAT 2 100.5 DEGREES EAST LONGITUDE





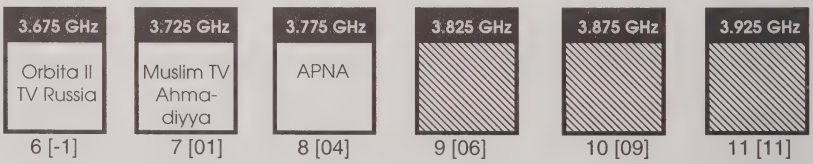
(H) HORIZONTAL POLARIZATION)

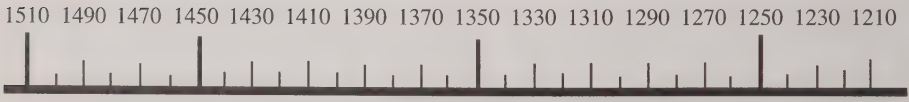
(V) VERTICAL POLARIZATION

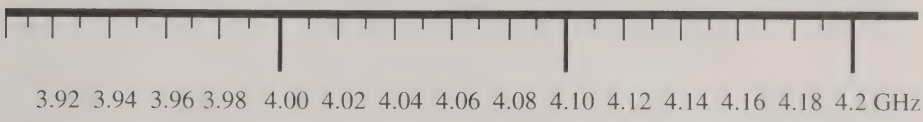
StarTV MPEG2 DigiStar transmissions use a number of AsiaSat2 transponders including 3A for closed key conditional access services to various Asian markets. At time of printing none of these services were intended for Australia or New Zealand.

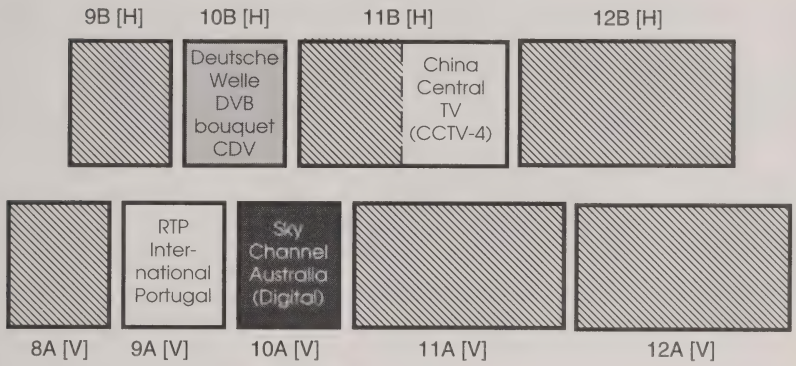
STATSIONAR-21 103 DEGREES EAST LONGITUDE

Right Hand Circular

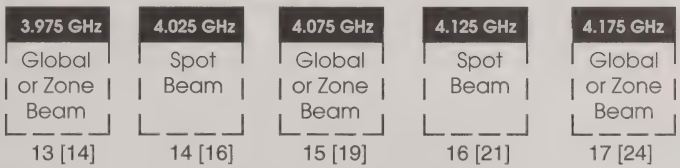


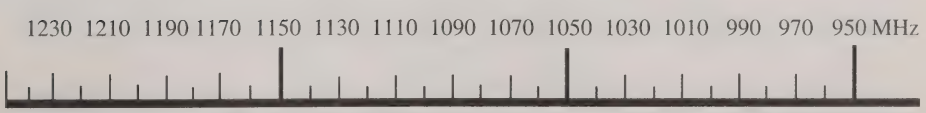


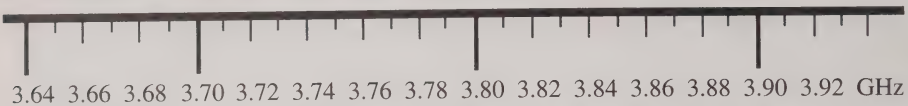




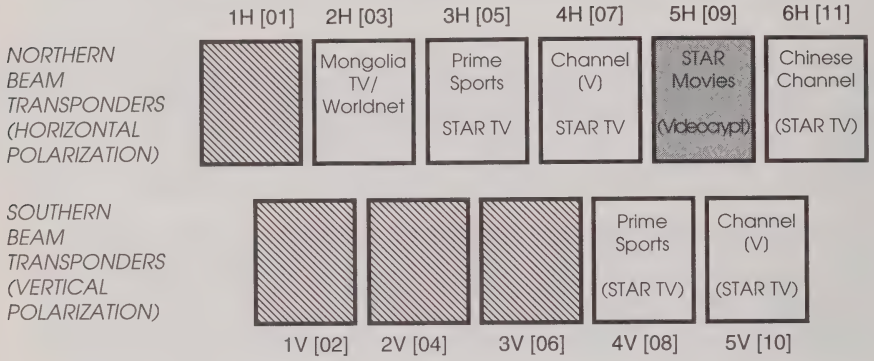
(Note: Future Statsionar "Express" class satellites serving the Asia/Pacific Region will carry the five additional C-band transponders illustrated below.)



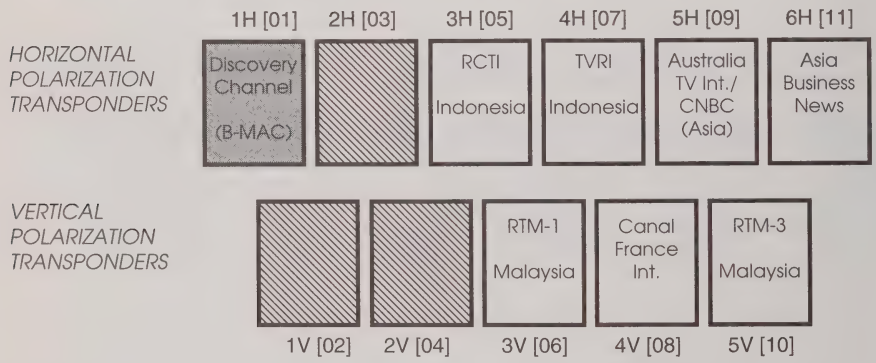


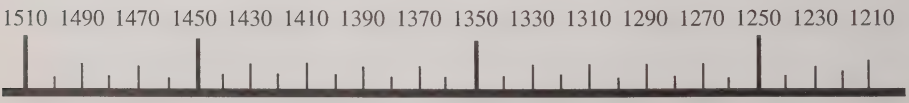


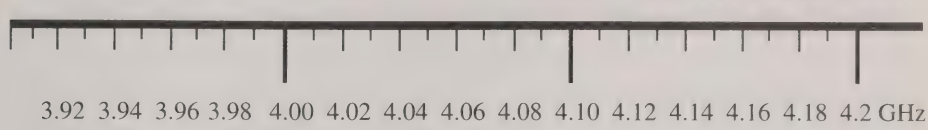
ASIASAT 1 105.5 DEGREES EAST LONGITUDE



PALAPA C2M 113 DEGREES EAST LONGITUDE





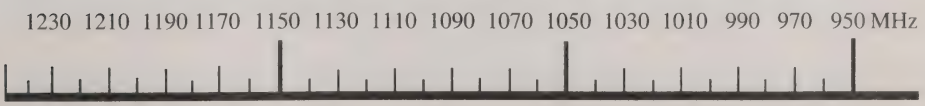


7H [13]	8H [15]	9H [17]	10H [19]	11H [21]	12H [23]
STAR Plus		Yunnan TV/ Guizhou (PRC)		China Central Television (CCTV-4)	

6V [12]	7V [14]	8V [16]	9V [18]	10V [20]	11V [22]	12V [24]
EL TV (STAR TV)	ZEE TV/ Doordar. (STAR TV Service for India)	STAR Plus	ZEE CINEMA (STAR TV Service for India)	Pakistan TV	Myanmar TV (Burma)	STAR Movies (Encrypt)

7H [13]	8H [15]	9H [17]	10H [19]	11H [21]	12H [23]
Surya Citra Televisi SCTV-Indonesia	HBO Asia (B-MAC)	GMA Philippines	TPI Indonesia	MTV Asia	TVBS (Encrypt-CDV)

6V [12]	7V [14]	8V [16]	9V [18]	10V [20]	11V [22]	12V [24]
TNT/ Cartoon (B-MAC)	CNN Int. (B-MAC)	ANTEVE Indonesia	TV Indosiar Indonesia	ESPN Int. (B-MAC)	9 Network Aust./ SBC/ TV Brunei	STAR TV (Music, Sports, Movies)



CHINASAT-5 115.5 DEGREES EAST LONGITUDE

HORIZONTAL POLARIZATION TRANSPONDERS

1H [01]	2H [03]	3H [05]	4H [07]	5H [09]	6H [11]
	Zhejiang TV (PRC)	CCTV-2 (PRC)	Xiznag TV (Tibet)	CCTV-1 (PRC)	

STATSIONAR R1 130 DEGREES EAST LONGITUDE

(All transponders transmit using Left Hand Circular Polarization.)

3.675 GHz	3.725 GHz	3.775 GHz	3.825 GHz	3.875 GHz	3.925 GHz
RAJ TV (Tamil)	SUN TV (Tamil)	IBC-13 Test Bct.	Asianet (India)	Gemini TV (Teluga)	Money TV
6 [-1]	7 [01]	8 [04]	9 [06]	10 [09]	11 [11]

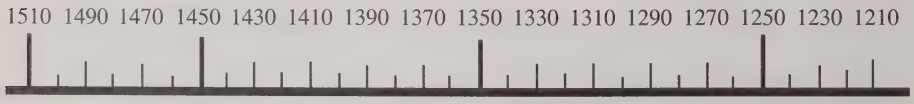
APSTAR 1 138 DEGREES EAST LONGITUDE

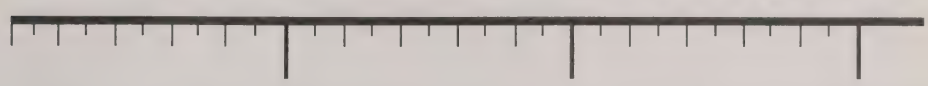
1A [-2]	2A [02]	3A [05]	4A [07]	5A [09]	6A [11]
		CETV Shandong (PRC)	CETV-2 (PRC)	CETV-1 (PRC)	

APSTAR 1 HORIZONTAL TRANSPONDER SET (A)

1B [-2]	2B [03]	3B [06]	4B [08]	5B [10]
CDV Services CBS, Rainbow, CSTV. APTV, Taiwan Satellite TV Channel			MTV Mandarin (B-MAC)	

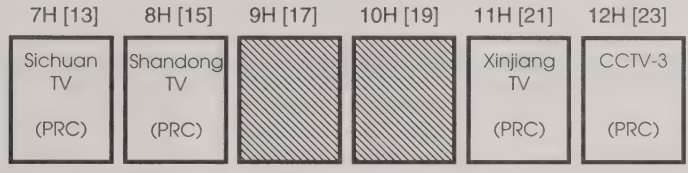
APSTAR 1 VERTICAL TRANSPONDER SET (B)



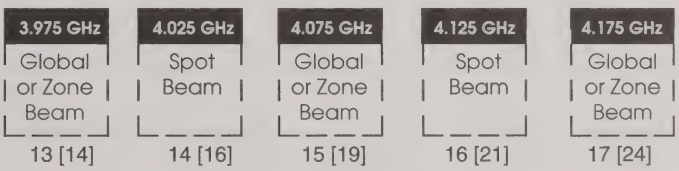


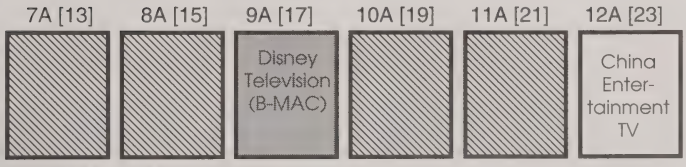
3.92 3.94 3.96 3.98 4.00 4.02 4.04 4.06 4.08 4.10 4.12 4.14 4.16 4.18 4.2 GHz

Chinasat-5 C-band beam coverage is restricted to locations in northern Asia. All vertically polarized transponders (not shown) transmit non-video voice and/or data.

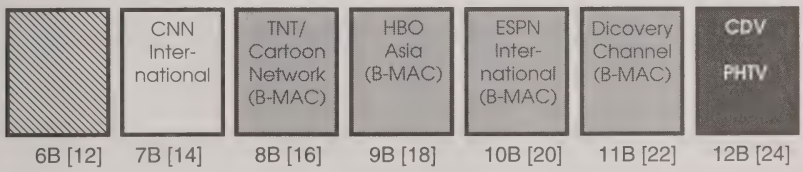


Future Statsionar "Express" class satellites serving the Asia/Pacific Region will carry the five additional C-band transponders illustrated below.



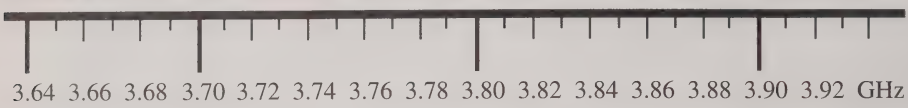


APSTAR 1 HORIZONTAL TRANSPONDER SET (A)



APSTAR 1 VERTICAL TRANSPONDER SET (B)

1230 1210 1190 1170 1150 1130 1110 1090 1070 1050 1030 1010 990 970 950 MHz



STATSIONAR-7 140 DEGREES EAST LONGITUDE

(All transponders transmit using Right Hand Circular Polarization.)

3.675 GHz	3.725 GHz	3.775 GHz	3.825 GHz	3.875 GHz	3.925 GHz
Orbita I TV Russia	Muslim TV Ahma-diyya				
6 [-1]	7 [01]	8 [04]	9 [06]	10 [09]	11 [11]

STATSIONAR-R2 142.5 DEGREES EAST LONGITUDE

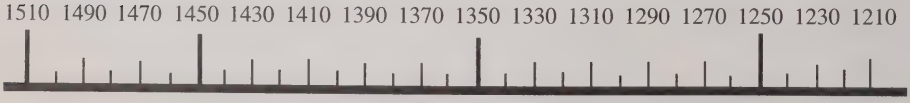
(All transponders transmit using Left Hand Circular Polarization.)

3.675 GHz	3.725 GHz	3.775 GHz	3.825 GHz	3.875 GHz	3.925 GHz
ATN	JJTV		Vijay TV (Tamil)	EMTV (PNG)	Sun TV Network/ Udaya TV
6 [-1]	7 [01]	8 [04]	9 [06]	10 [09]	11 [11]

STATSIONAR-16 145 DEGREES EAST LONGITUDE

(All transponders transmit using Right Hand Circular Polarization.)

3.675 GHz	3.725 GHz	3.775 GHz	3.825 GHz	3.875 GHz	3.925 GHz
Orbita I TV Russia				Dub'l I TV Russia	
6 [-1]	7 [01]	8 [04]	9 [06]	10 [09]	11 [11]

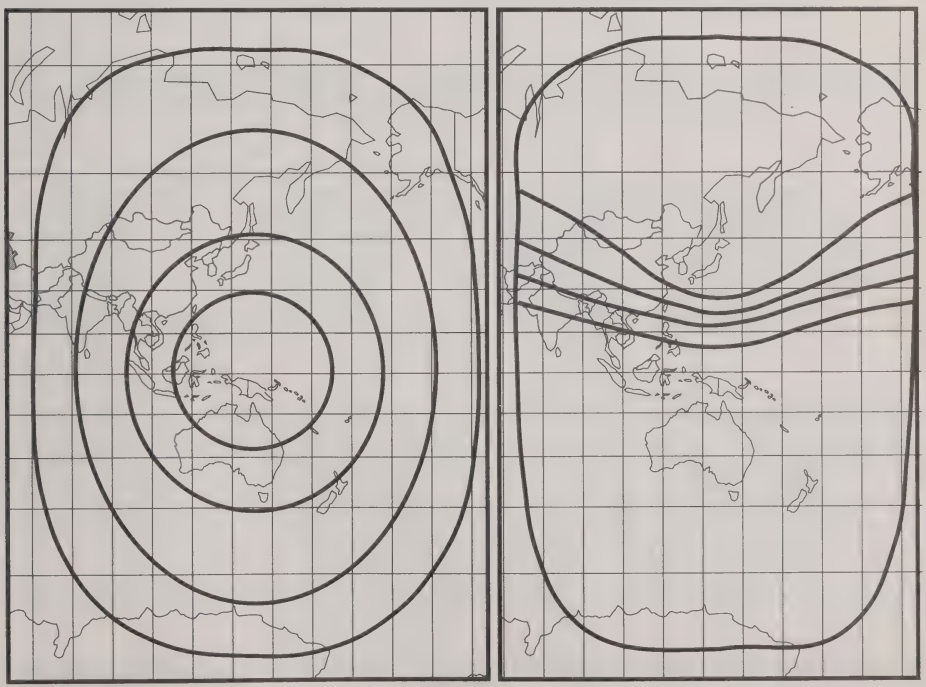


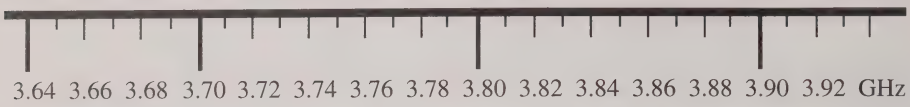
Future Statsionar "Express" class satellites serving the Asia/Pacific Region will carry the five additional C-band transponders illustrated below.

3.975 GHz	4.025 GHz	4.075 GHz	4.125 GHz	4.175 GHz
Global or Zone Beam	Spot Beam	Global or Zone Beam	Spot Beam	Global or Zone Beam
13 [14]	14 [16]	15 [19]	16 [21]	17 [24]

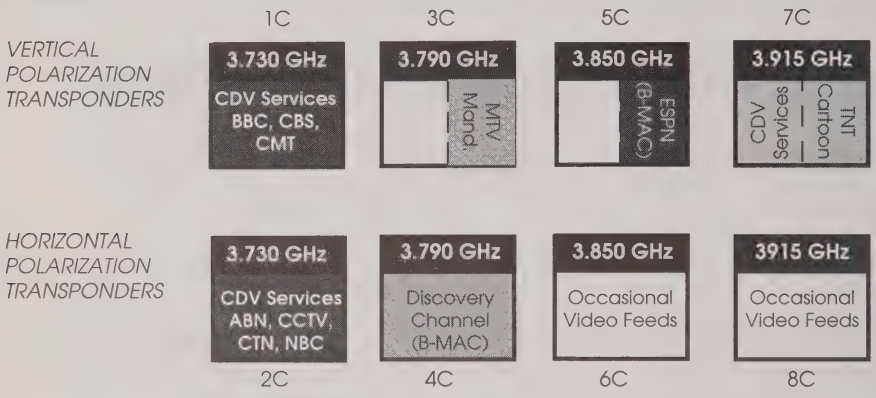
Statsionar-16 Low Power Global Beam Coverage from 145 degrees east longitude. Contours: -1, -2, -3 & -4 dB from maximum EIRP of 28 dBW. SOURCE: INTERSPUTNIK.

Statsionar-16 Zone Beam Coverage from 145 degrees east longitude. Contours: -2, -4, -6 & -10 dB from maximum EIRP of 34 dBW. SOURCE: INTERSPUTNIK.

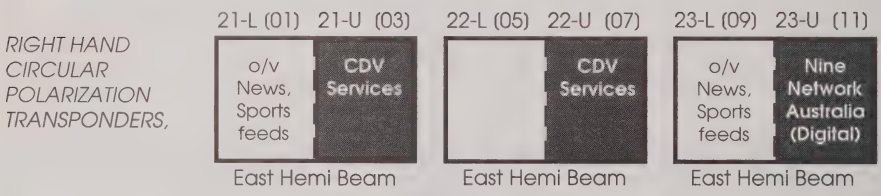




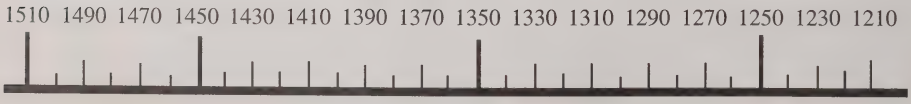
PAS-2 169 DEGREES EAST LONGITUDE

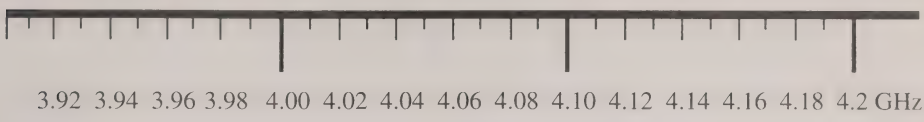


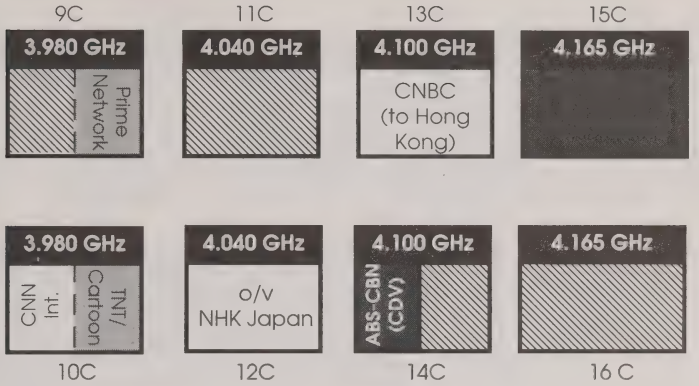
INTELSAT 511 180 DEGREES EAST LONGITUDE



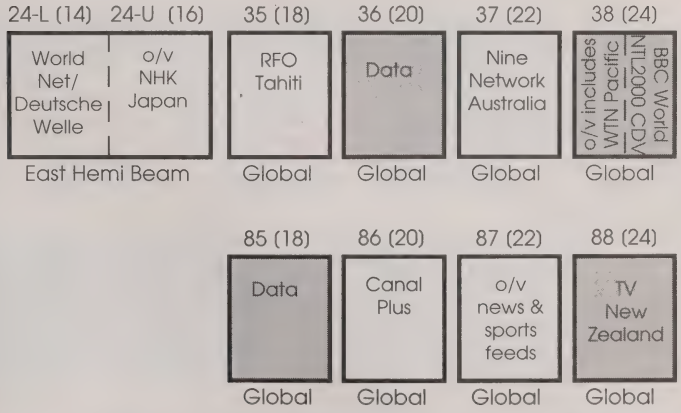
LEFT HAND CIRCULAR POLARIZATION TRANSPONDERS,

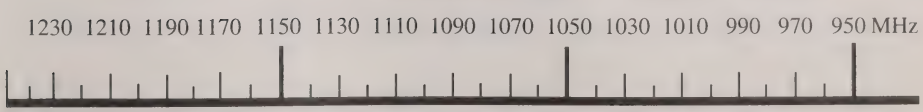


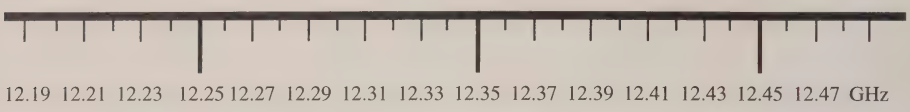




(Note: Global beam transponder 38 (24) on the INTELSAT 701 and INTELSAT 703 satellites located at 174 and 177 degrees east longitude, respectively, also is used for occasional video news and sports feeds.)







OPTUS B1 — 160 DEGREES EAST LONGITUDE

VERTICAL POLARIZATION TRANSPONDERS can be switched through footprint options indicated.

1	2	3	4
12.282 GHz SCPC & Data	12.344 GHz Voice & Data	12.407 GHz Itenerant Video 7 Network Feed(E-PAL)	12.470 GHz 10 Network Interch.(PAL) 10 Network Feed(E-PAL)
NA/SE/NZ	NA/SE/NZ	NA/SE/NZ	NA/SE/NZ

HORIZONTAL POLARIZATION TRANSPONDERS can be switched through footprint options indicated.

9	10	11
12.3132 GHz Civil Aviation Authority Australia	12.3758 GHz	12.4384 GHz
NB	NB	NB/NE

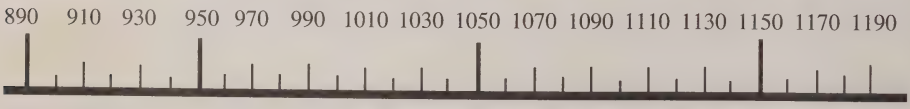
OPTUS B3 — 156 DEGREES EAST LONGITUDE

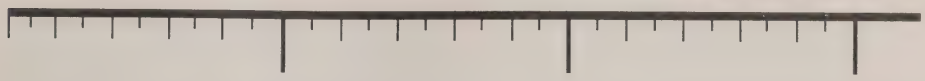
VERTICAL POLARIZATION TRANSPONDERS can be switched through footprint options indicated.

1	2	3	4
12.282 GHz SCPC Data & Optus StarNet	12.344 GHz ~~Itenerant Video~~	12.407 GHz Itenerant Video	12.470 GHz Data various
NA/SE/NZ	NA/SE/NZ	NA/SE/NZ	NA/SE/NZ

HORIZONTAL POLARIZATION TRANSPONDERS can be switched through footprint options indicated.

9	10	11
12.3132 GHz Civil Aviation Authority Australia	12.3758 GHz Galaxy (CETV) Pay TV (DVB/IRDETO)	12.4384 GHz Galaxy (CETV) Pay TV (DVB/IRDETO)
NB	NB	NB/NE





5
12.5323 GHz
Itenerant Video | Itenerant Video
NA/SE/NZ

6
12.5949 GHz
OmniCast data | Sky Channel (B-MAC)
NA/SE/WA/NZ

7
12.6575 GHz
ABC N.S.W. HACBSS (B-MAC) | SBS HACBSS (B-MAC)
NA/SE/WA/NZ

8
12.7201 GHz
9 Network Interchange | Sky Channel & 9 Network Interchange
NA/SE/WA/NZ

12
12.5010 GHz
9 Network Feed(E-PAL)
NB

13
12.5636 GHz
ABC TV Interchange (PAL) | ABC Radio (Digital)
NB

14
12.6262 GHz
ABC TV QLD HACBSS (B-MAC) | SBS TV HACBSS (B-MAC)
NB/NE/CA

15
12.6888 GHz
QTV Queensland (B-MAC) | Data
NB/NE/CA

5
12.5323 GHz
Itenerant Video
NA/SE/NZ

6
12.5949 GHz
Golden West Network (B-MAC)
NA/SE/WA/NZ

7
12.6575 GHz
~~Itenerant Video including EDTV Schools TV VIC (CryptoVision).~~
NA/SE/WA/NZ

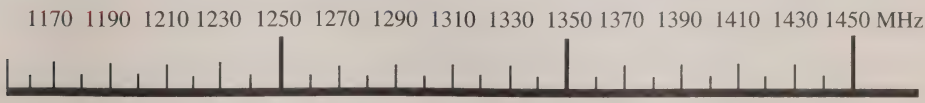
8
12.7201 GHz
ABC TV W.A. HACBSS (B-MAC)
NA/SE/WA/NZ

12
12.5010 GHz
~~ABC TV S.A. HACBSS (B-MAC)~~
NB

13
12.5636 GHz
Data Telstra
NB

14
12.6262 GHz
~~IMPARJA TV (B-MAC)~~
NB/NE/CA

15
12.6888 GHz
~~ABC TV N.T. HACBSS (B-MAC)~~
NB/NE/CA



ADDITIONAL SATELLITE INFORMATION RESOURCES

SPACE PACIFIC

The Pacific Ocean Region's first private satellite system user's organization, *SPACE Pacific Incorporated,* grew out of attendee discussion during the September 1994 Satellite Cable Seminar in Hastings, New Zealand. PanAmSat's PAS-2 satellite had been operational only a few weeks and the attendees properly saw home satellite TV systems entering a transitional stage. Following nearly a decade of quasi-scheduled larger antenna only (3m and up) reception restricted to feeds found on INTELSAT's ageing Pacific satellite fleet, "real" DIRECT-TO-HOME (DTH) satellite TV was arriving with the promise of totally geostationary satellites, C-band antennas as small as 1.8 meters, and scheduled programming actually intended for private dish viewing.

The industry group properly anticipated a period of adjustment during which home satellite TV was forecast to become, as elsewhere in the world, more of a consumer appealing regular service and less of a hobbyist oriented technical challenge.

SPACE (Satellite Programme Access CommittEe) was founded to deal with these issues and to build a trade association capable of representing the needs of its members.

By late 1994, *SPACE* had learned to be an effective lobbying force on behalf of its rapidly growing membership from the Solomons to New Zealand, and from Australia to French Polynesia. Country Music Television, ABS-CBN, CNN International and other programmers subsequently agreed to a *SPACE* proposal to make their programming available for DTH reception.

SPACE operates several membership divisions for dish installers and sellers, home dish owners, commercial (motel, hotel) dish owners, and hardware/software (programming) interests. Members have access to *SatFACTS,* a monthly industry journal; a correspondence course in practical satellite system technology and a body of reference material that routinely provides hard-to-find answers to technical and operational problems. Information about *SPACE Pacific* is available from managing director Bob Cooper at P.O. Box 330, Mangonui, Far North, New Zealand.

ASIAPACIFIC SPACE REPORT

Space Media of Hong Kong publishes a monthly newsletter called *AsiaPacific Space Report* which supplies the latest information on developments in the region's commercial satellite, cable and DTH industries. The publication also regularly provides a updated report on Asian satellite TV and radio programming. Subscription information for *AsiaPacific Space Report* is available from Brian Jeffries, Space Media, 1902 Centre Mark, 287 Queens Rd., Central, Hong Kong.

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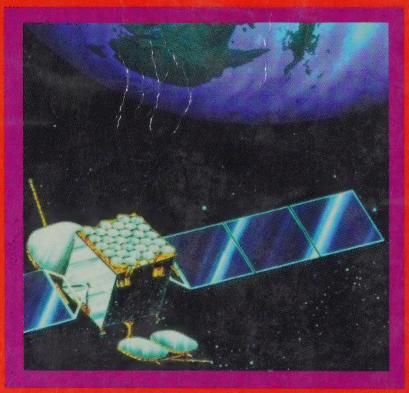

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